URBAN PUBLIC SPACES:

A study of the relation between spatial configuration and use patterns

Thesis submitted for the degree
of PhD in Architecture

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ABSTRACT

This thesis sets out to investigate the key spatial properties that make for successful urban public spaces; specifically, which spatial properties lead to high levels of static occupation and which spatial properties affect the patterns of static distribution of people inside public spaces. This is a subject which has long attracted attention among urban designers, amongst whom there is a general consensus that well-designed urban places are lively, busy and vibrant, and that these properties are somehow, albeit unclearly, connected with design variables.

However, in contrast to designers who often have treated public spaces as discrete spatial entities emphasising on localised spatial properties such as enclosure or quality and quantity of decorative elements, it is suggested that not enough has been done to understand the relationship between patterns of spatial use and global, relational features of public places. This research is therefore based on two propositions. The first is that the way public spaces are used is influenced by the permeable and visual connections that hold between the specific space under investigation and the configuration of the urban fabric where they are embedded and levels of pedestrian movement associated with it. The second is that these key spatial properties which are identified in the performance of public spaces can be found in traditional historical urban squares.

The morphological analysis of 30 traditional historical urban squares of European towns and 12 public spaces in the City of London, which compose the main case study for providing quantifiable evidence on levels and distribution of static people, revealed three major issues. Firstly, the level of static people inside public spaces is directly related to levels of pedestrian movement across the public space, quantified through the "strategic value", this being numerically defined as the sum of the integration values, or the degree of accessibility, of lines of sight and movement which pass through the body of the space. Secondly, the distribution of static people inside public spaces is inversely related to the level of visual connectivity between the internal areas of the public space and the surrounding grid, quantified by the degree of "coverage

density". Thirdly, only the spatial properties which have been identified to be common to both samples showed to be related with the patterns of spatial use of public spaces. Consequently, these findings shape a new approach to the issue of patterns of spatial use of public spaces, based on the global understanding of the dynamics of the urban grid and the visual and permeability connections between public space and the urban environment.

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Chapter 6
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1

INTRODUCTION

The objective of this research is through a morphological study of urban public spaces, to investigate which spatial properties lead to high levels of static occupation by people and which spatial properties affect the patterns of static distribution of people within the space, in so far as theoretical models for the analysis and prediction on their performance can be formulated. The research thus aims to assist designers on two levels: Firstly, to ensure that public spaces are going to be effectively used by people. Secondly, to assist designers in the fine-tuning of public spaces with a better understanding of how people distribute themselves in space.

1.1. THE PROBLEM DEFINITION

Public spaces, like streets, are all part of the continuous urban form. True, in the way urban form is configured and inhabited, public spaces are not the only urban territory where social presence can take place. However, streets are primarily places of transit, in contrast to "public squares" which despite embodying a certain degree of pedestrian through movement, are fundamentally places of destination for static activities.

Although it is accepted that overcrowding in public spaces can be a serious issue under very specific situations[1], it is clear that the underuse and not overuse is the major problem. Research has already suggested that the carrying capacity of most urban public spaces is far above the use that it made of them, where generally the

[1] As in the case of New Year's eve celebrations. Refer to Major et al., 1999.

people themselves determine the level of crowding, ie, there is a spontaneous self-levelling in case a public space gets too crowded[2]. However, in an attempt to explain why some public spaces are better used than others, the focus of most of previous studies in the subject have looked at the relationship between the public space design, its form and contents, and patterns of static people occupancy. While relationships have been claimed to be found between design and use, much of the variation in static occupancy levels is still unexplained in so far as the findings have not yet resulted in theoretical models where patterns of use can be predicted with confidence.

"What makes a good square good?" Clay asked this question in an article published back in 1958. According to Clay, action is the key to successful public spaces and in this regard there are three aspects to be considered. Firstly, Clay claims that the amount of activity in open spaces depends on the feeling that the spatial enclosure gives to people. Secondly, public spaces should encourage social mix since that adds life and vibrancy to the environment. Finally, public spaces should contain fountains because they are able to transform "dry spots into places of delight, of joy, wonder, surprise, and beauty" (Clay, op.cit., p153). Clay's conclusions are rather subjective, as he does not explain how the "feeling" of enclosure can in real terms affect the amount of static activity. However, it shows clearly that the performance of public spaces has been an issue of concern for some while.

Clay was not the first to address this problem. Much earlier, Camillo Sitte had already addressed the question with the publication of *The Art of Building Cities*[3] in 1889. In his book, Sitte, through a comprehensive study of medieval and renaissance urban squares, investigates the salient spatial elements that make for successful urban squares. Since then, many city planners and designers have recognised the importance of attractive usable spaces as spaces for "social interaction" and other forms of urban activities providing places to socialise, eat or relax. Public spaces play a critical role in maintaining the attractiveness of public areas as places to visit and stay where the population can take advantage of a good environment.

The most important and widespread interpretation, probably influenced by Sitte's ideas, is that in order to be successful, by means of good levels of static occupancy, public spaces should observe spatial enclosure (the continuos frame of buildings around an open space) and irregularity (the disruption of symmetry of surrounding buildings), which were derived from studies of traditional medieval squares. Only

[2] Whyte, 1980.

[3] Original title: Der Städtebau.

enclosed spaces and the lack of symmetry of the surrounding buildings could provide the users with a sense of well being, comfort and pleasure, and therefore ultimately determine the preference by the public for such areas. Also, there is general agreement by planners and designers that the quality and quantity of decorative elements, from fountains, green areas, detachment of vehicular movement to the availability of seats or the aesthetic quality of surrounding buildings, are all important elements for ensuring that public spaces are successful.

This thesis disputes such ideas. The reality of informal observation of public spaces suggests otherwise. Despite attempts by many authors to understand the morphology and principles governing patterns of spatial use of open public spaces, the current state of knowledge gives little effective guidance to designers. It is still possible to find many examples of current developments that were designed with these ideas in mind that have failed dramatically to be a dynamic environment due to low levels of static people occupancy. Often, public areas either in housing estates, office developments or simply in areas of the public domain which were designed with the clear intention of working as a popular public space, are relegated to deserted areas rather than lively urban spaces, whereas other areas, perhaps not planned to work as "public squares" seem to incorporate all the necessary elements and have become popular.

Figures 1.1 and 1.2 illustrate two distinctive public spaces, Crosby Square and Moor House in the City of London. Both photographs were taken during the lunchtime period in the early autumn of 1996. The first example (Fig. 1.1), Crosby Square, is a purpose-designed public space, which embraces all the spatial and formal properties of a "good square" according to the criteria discussed previously. It is an enclosed space, provided with adequate seating facilities, well maintained and surrounded by fine architecture. Yet, it is empty despite the time of day. Moor House (Fig. 1.2), which is not a designated public space[4], is a very informal area, the antithesis of the first case, open and unsophisticated, not very clean, with people sitting on the walls of the raised flowerbeds, but certainly far more popular than Crosby Square as a destination place throughout the day with good levels of static people occupancy.

[4] Francis (1987b) calls it a "found space", which it is the designated terminology for spaces not purpose-designed as public squares.

plan scale: 1:4000

view A

Figure 1.1. Crosby Square

plan scale: 1:4000

view B

Figure 1.2. Moor House

One could suggest that what makes Moor House so successful in comparison to Crosby Square is the presence of sandwich shops which work as attractors in bringing people in. However, our cities are full of examples of retail outlets that fail because the "location seems to be wrong". In fact, there are many examples of public spaces with wine bars, for instance, in the vicinity with very low levels of static people throughout the day. Recent research, most notably by Whyte (1980) and Hillier (1984) has started to challenge such ideas. Studies where levels of static occupancy were analysed against design and function variables which had been thought to be candidate explanations for the popularity of public spaces, have concluded that the relation to adjacent streets and the levels of pedestrian movement associated with them were the real key factors for their success.

This thesis is guided by the belief that if there are still public spaces being designed that fail to be lively successful public spaces, the reason for such failure being that many designers still perceive public spaces as spatial elements regardless of their interface with the surrounding grid. Too much emphasis has been devoted to local spatial properties such as enclosure and not enough has been done to understand the relationship between pattern of spatial use, its levels and spatial distribution, and spatial properties of the urban grid in which the public space is embedded. The study aims to clarify the proposition that ideas on spatial enclosure, spatial and functional elements are complementary rather than determinants of the functioning of public spaces. Without a global understanding of the urban realm by a comprehension of the city through its parts and how they relate to the whole, we will inevitably misunderstand the real issues concerning patterns of use of public spaces.

1.2. THE SCOPE OF THE RESEARCH

This thesis sets out to investigate the spatial properties, if there are any, which make urban public spaces to work or fail to work. It is particularly concerned with assessing what spatial factors promote the "unprogrammed" use of space, that is, informal sitting, conversing or simply watching people, in contrast to the more "programmed" activities associated with the provision of catering outlets or leisure facilities, though the research is also interested in these. Assessment of the level of use of spaces is based on direct observation of static people occupancy, and the spatial analysis of public spaces uses space syntax methods and pays particular attention to the embedding of space in the large scale structure of the urban grid and the detailed properties of visual fields available in and around the public spaces. No attempt is made to investigate the psychology of individuals using public spaces, or to assess their motivations. The evidence used is the objective properties of space and objectively observed behaviour in those spaces.

The terminology concerning public spaces can be quite diverse if not confusing. There is one basic distinction: urban open spaces of soft material landscapes are generally referred to as "parks"; and urban open spaces of hard material landscapes are generally referred to as "public spaces", although "public square", "urban square" or a "building plaza" are also common (Morris, 1979). In addition, an extensive differentiation in the terminology is found mainly in American studies, due to attempts by authors to create specific design guidelines according to each definition. For instance, a "downtown plaza", or simply "plaza", is an open or partially enclosed public space specially designed for active pedestrian uses and passive recreation, readily accessible and adjacent to the sidewalk. "Vest pocket park", is defined as a small hard-material public space developed from a left over plot between high rise buildings with only one access from the adjacent street. A "square" is normally a larger public area such as an extension of the streetscape providing a central focus for a district or (historical) area. A "shopping plaza" is defined as an atrium surrounded by an arcade of retail outfits[5].

The scope of this research is much broader since it does not restrict itself to "vest pocket parks" of "piazzas" in the terms just described. There will be no distinction as to whether the public space was developed as part of a new office block or as part of the historical development of a city centre. The criterion for public spaces being part of the investigative process is whether they are freely accessible destinations. They do not necessarily have to be purpose designed spaces, but they must have the potential for being used as a setting for human gathering where users have the freedom of action and the chance for social encounters, focusing eventually on public spaces[6] in the City of London. The terminology used in this thesis will be the generic term "public spaces". However, if any other term is employed such as "market square" it is because it is the designation used by the author of the original text.

Since the aim of this research is to look at the relationship between urban grids and public spaces, artistic or decorative elements and proportions such as the relationship of floor area and the heights and functional elements of surrounding buildings, or the number of seating areas, are not analysed. Likewise, this research will not cover aspects such as weather variables (although it will ensure that public spaces are observed under reasonably good comparable weather conditions), ownership or management. Finally, no attempt will be made to understand or to explain the historical process, or the socio-economic or political context of the public spaces under investigation.

1.3. THE STRUCTURE OF THE ARGUMENT AND THESIS OUTLINE

This research takes its starting point two propositions that emerged from early studies carried out by Hillier (1984, 1988). The first proposition is that the pattern of public spaces use, that is, the level and distribution of both pedestrian movement and stationary people, is a function of the degree of permeability and visibility between the public space and the configuration of the urban fabric where it is embedded. The

[5] All examples are from Miles et al., 1978.

[6] A detail discussion of the spatial representation of public spaces is presented in Chapter 2.

second proposition is that if there is a relationship between spatial regularities of contemporary public spaces and their level of performance, this can be translated in a number of morphological characteristics previously found in traditional historical urban squares. In order to investigate which spatial properties lead to high levels of static occupation by people and which spatial properties affect the patterns of static distribution of people within the space, based on the two propositions, the thesis is structured and organised around seven chapters, as follows:

- This first chapter has introduced the subject and aims of the research project. It started by presenting the problem of definition. Chapter 1 will then shape the argument, outlining how the thesis is structured with reference to its objectives and reviewing the contents of the subsequent chapters.

- Chapter 2, the literature review, deals with a critical review of the current state of knowledge on the performance of open urban spaces, presenting the work of the most influential and relevant authors with the pertinent points to be explored in further analyses. The work done by authors who focus on the theoretical analysis of the morphology of public spaces with evidence drawn from historical examples will be described first. Secondly, the work done by those who were involved with the empirical analysis of the functioning of public spaces will be discussed. An important aspect of the first two main bodies of literature is that both tend to discount the influence of the surrounding grid as an important element for public spaces level of performance, and instead pay much attention to local spatial properties such as enclosure and internal spatial elements. The third section introduces the work of authors who break with the tradition of emphasising spatial enclosure and discuss the "embeddedenes" of the public spaces as an important feature for their degree of success. Space syntax is then presented as the main analytical tool for the spatial analysis of public spaces, and relevant work using the space syntax methodology is described. The last section presents ideas on gradual occupation and preferred areas for static activities.

- Chapter 3 examines the morphological properties of a sample of traditional urban squares in order to develop a methodology capable of describing their form and the way they are embedded in the urban fabric, in the expectation that common morphological characteristics might be relevant to the patterns of use of contemporary public spaces. It describes a morphological analysis of a sample of 30 traditional squares in European towns, dating from the XI to the XV Centuries. The analysis focuses on a description of their form and their embedding in the urban fabric, with concepts derived initially from the literature review. It is divided into three levels, and this defines the main structure of the chapter. Firstly, the analysis addresses the two-dimensional description of space investigating properties such as spatial enclosure and visual fields. Secondly, the analysis focuses on the spatial properties of access and visibility at the immediate local level interfacing within the body of the public space. Thirdly, an analysis is made at a global level of the surrounding grid, in order to describe the relative importance of the public space in the overall structure of the urban fabric.

- The objective of Chapter 4 is to carry out a morphological analysis of twelve "in-use" public spaces in the City of London which compose the main case study of this thesis, using the same methodology of space description developed in Chapter 3. In addition, Chapter 4 aims, through a comparative study, to analyse to what extent both samples of traditional and contemporary public spaces share common morphological characteristics. The chapter is structured in three main sections. It starts by introducing the reason for selecting the area of City of London for fieldwork and gives the criteria for selecting the final sample of public spaces, which incorporate the spatial elements identified in the literature review relevant for their success. The second section introduces the methodology for comparing traditional and contemporary public spaces. The third section, is the morphological analysis, and follows the same structure as Chapter 3.

- The aim of Chapter 5 is to investigate the relationship between the spatial properties of the public spaces in the City of London and levels of pedestrian movement and static occupancy of space. From the previously identified morphological characteristics in the sample of City of London public spaces in Chapter 4, Chapter 5 uses empirical data from an in-depth study of levels of both pedestrian movement and static occupancy and statistically correlates them with the spatial properties. The objective is to study how far the overall use levels of City of London spaces could be shown to be influenced by the spatial variables from the morphological study in Chapter 4. The analysis is done in two stages. The first stage covers numerical information of levels of pedestrian movement inside the selected public spaces and in the surrounding area and correlates them against spatial properties. With this in the background, levels (as opposed to distribution) of static use are studied. The aim of this second section is to study the form and the way in which public spaces are embedded in the urban grid as a predictor of levels of spatial use. At this point, ideas about the relations between spatial properties and levels of static use first set out in the Mansion House Square Study (Hillier,

1984) with reference to the "strategic value"[7] will be tested. Once the basic analysis of movement and static levels has been presented, the chapter will conclude with a discussion on the relationship between levels of static occupancy and pedestrian movement.

- Chapter 6 comprises a further analysis of the performance of public spaces, focusing on the relationship between spatial properties and patterns of pedestrian movement and the distribution of static use within space. It aims to investigate the relationship between movement and static behaviour in relation to detailed design features of public spaces and their degree of permeability and visibility with in the urban grid. Chapter 6 is divided into two major sections: the first section looks at patterns of pedestrian movement investigating how far public spaces are used as routes between destinations and what the deterrents to their use as a route are. The second section deals with the distribution and gradual occupation by static people of space, according to the type of user and activity. Chapter 6 also introduces a new methodology, which enables the investigation of static people preferred location and gradual occupation of space in relation to the visual connection of the surrounding grid, denominated as the "overlapping point isovists analysis". Once both sets of properties are analysed, this chapter examines the results of interviews carried out with public space users.

- Chapter 7 comprises a general discussion, bringing together the findings of the previous chapters. The relationship between spatial design and human behaviour, based on the outcome of the research, is used to suggest theoretical models for the analysis and prediction of patterns of space use. The chapter looks at how the findings on the spatial elements common to both samples, traditional and contemporary in–use ones relate to the criteria for successful public spaces and present ideas on predictive models.

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[7] The concept of strategic value will be discussed in detail in Section 2.5 of Chapter 2.

2

IDEAS FOR A SUCCESSFUL PUBLIC SPACE

This chapter gives a critical review of the current state of knowledge on design ideas on the morphology and performance of urban public spaces. Five main bodies of literature are examined. Authors whose work is based on historical evidence and who focus on the analysis of morphology of traditional public spaces to extract the relevant spatial aspects to achieve successful public spaces are considered first. Secondly, the chapter discusses the work done by those who were involved with the functioning of public spaces, based mainly on an analysis of modern examples. A common denominator of the work of the first two bodies of literature is that both groups understand public spaces as independent spatial entities discounting the importance of the connections between the public space and its wider surroundings. Thirdly is presented the work of those authors who, although they look empirically at the performance of public spaces, see the street and the levels of pedestrian movement associated with it as the key element for their performance. The need for a theory that allows for the description, quantification and interpretation of the spatial configuration and therefore the importance of the space syntax methodology to deal with the analysis of the performance of public spaces is discussed. The findings of relevant work on the performance of public spaces produced using space syntax methodology are then introduced. Lastly, ideas on the gradual occupation and preferred areas for unprogrammed static activities in public spaces are presented.

2.1. MORPHOLOGICAL STUDIES OF HISTORICAL URBAN SQUARES

The starting point of this PhD concerns the study of elements found in traditional urban squares and how they can illuminate the understanding of contemporary examples. This section examines the approach of authors who have studied the morphology of public spaces focusing on elements that were present in historical examples and, according to them, produced successful public spaces. The basis of the theoretical approach of this research is similar to the methodology of those authors as it also looks at examples of traditional public spaces as a form of identifying common morphological characteristics to better understand the performance of contemporary examples. Although, as will be discussed in due course, the findings concerning the morphological characteristics identified by the relevant authors are not necessarily the ones identified in this research, their work is nevertheless illuminating.

Camillo Sitte's (1889) ideas on the morphology of traditional "urban squares"[1] influenced the work of a generation of authors. One of Sitte's major contributions is his pioneering analysis of the spatial morphology of traditional urban squares, as a means of understanding the "failure" of modern urban squares. Sitte claims that modern examples (here Sitte is referring to late XIX Century cases) are unsuccessful, meaning low levels of static occupancy, because they constantly fail to be places for people to gather in contrast to the medieval cases, which were used for a number of social purposes. In order to investigate "the elements of composition that formerly produced such harmonious effects, and those which today produce only loose and dull results" (Sitte, op.cit., p2), Sitte analyses the spatial relationship between Medieval and Renaissance urban squares and both the surrounding streets and important buildings (like churches) placed in non-regular urban grids to examples from the late XIX Century. Sitte concludes that the failure of contemporary cases have occurred because they did not reproduce the two fundamental characteristics of mediaeval examples, that is, spatial enclosure and irregularity.

Sitte claims that spatial enclosure, defined by the grouping of architectural masses around an open space (Ibid., p45), is the most relevant aspect of a successful urban square. Enclosure is the only element capable of distinguishing an "open space" (in

[1] "Urban squares" is the terminology employed by Sitte and most of the other authors in this section.

this case implying an unsuccessful space) from an "urban square" (that is, a successful space) because enclosure and stimulation of pleasure are close related (Ibid., 59). According to Sitte, the fundamental principle, which was applied in traditional squares to achieve the enclosure effect, is how streets enter the body of the urban square. Only one street at each corner of the square should be used and if more are needed they must be connected at different angles (Fig. 2.1a). This principle contrasts with late XIX Century examples, when it was normal practice to join two streets at right angles, as exemplified in Fig. 2.1b.

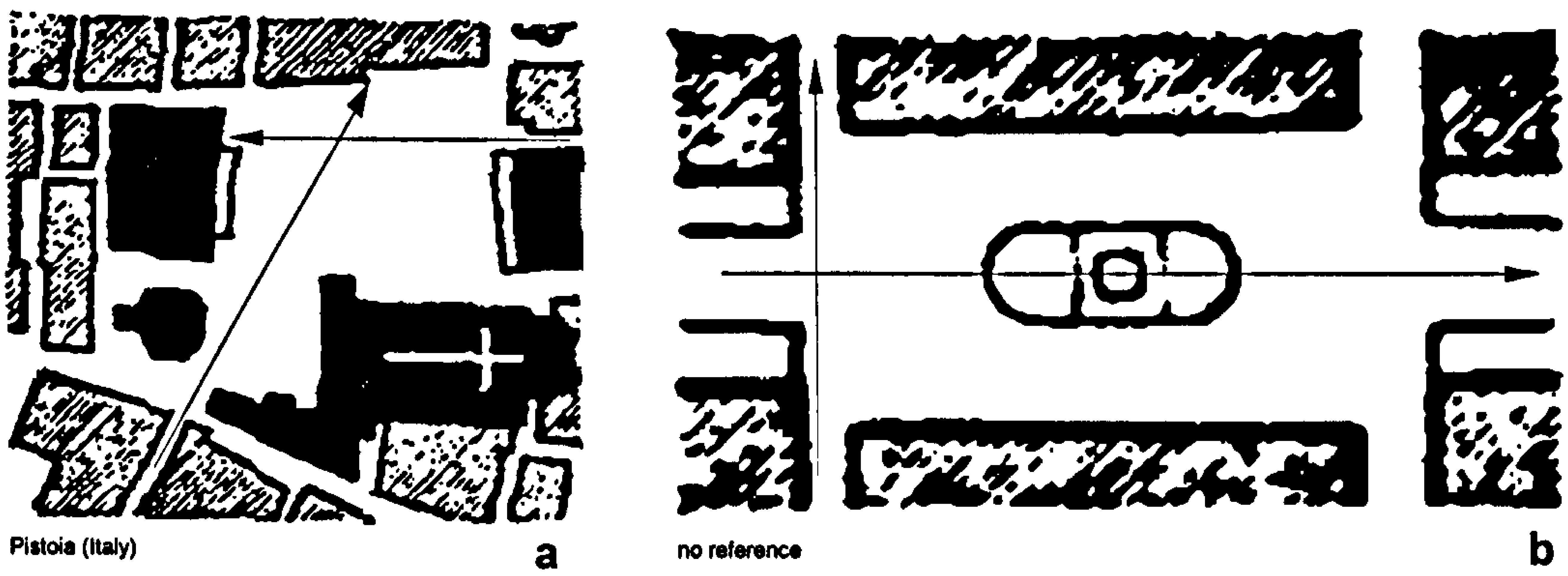
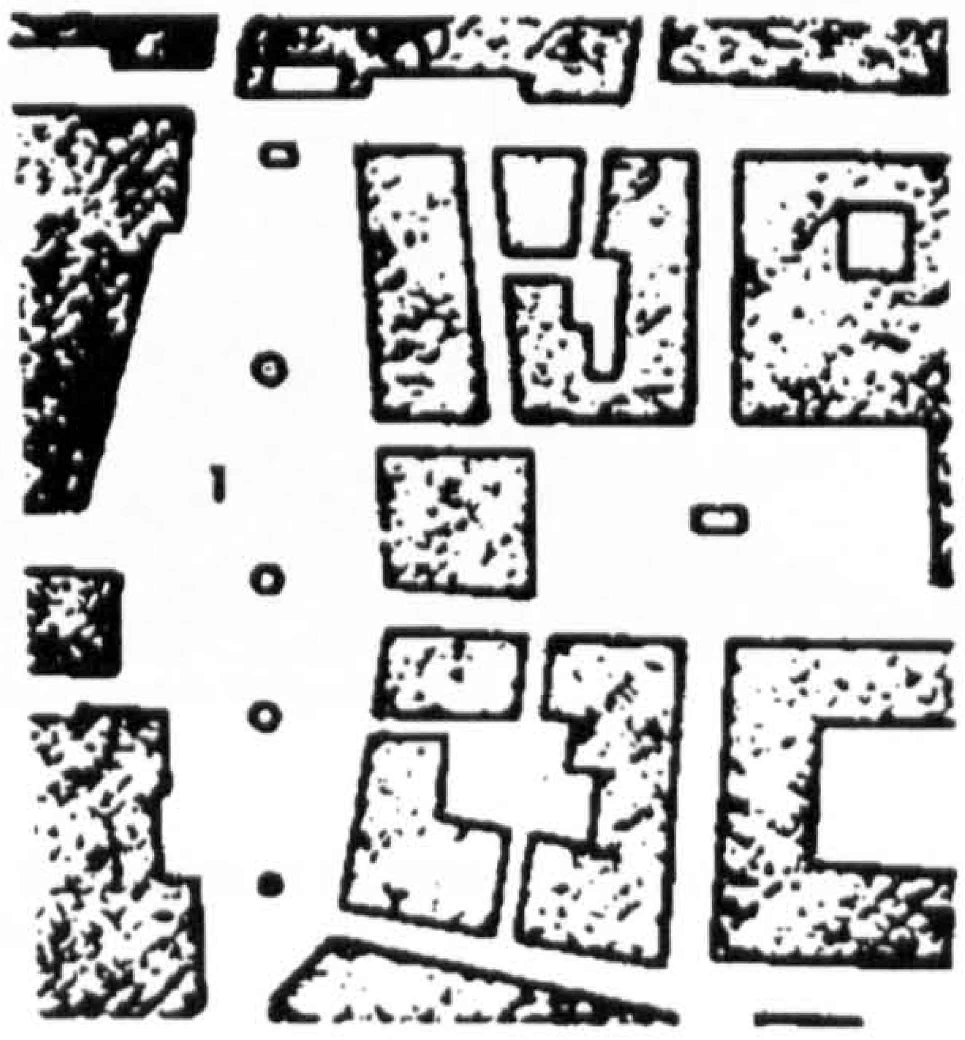


Figure 2.1. Examples of how entry points can characterise spatial enclosure
Sitte, 1889.

One of the key means of achieving the enclosure element in urban squares is therefore the treatment of the corners. The more open the corners are, the less the sense of enclosure, whereas the more built up the corners are, the greater the feeling of being enclosed. As it is possible to see in Figure 2.1a (highlighted by the arrows) the method used in traditional squares, meaning that, from any entry point to the urban square the observer will face a building façade instead of a view of another street as in Figure 2.1b. Once inside, no more than a single view (to the entry point) at a time would be possible for the observer. Sitte points out that the use of portals at street exits and arcades around the open space was a common practice in the design of traditional squares to enhance the sense of enclosure, in contrast to the tendency of the late XIX Century to open the urban space at all sides, causing the cohesive effect of the square to be nullified (Ibid., p24).

The second important concept identified by Sitte is the property of "irregularity", which he defines as the disruption of the symmetry of surrounding buildings, as shown in Figure 2.2. Sitte argues that irregularity is important since it can contribute to a picturesque character and avoids giving an "unpleasant appearance" (Ibid., p30) to the urban space thanks to the level of surprise that disrupted symmetry creates: observers are faced with new and unexpected views as they move inside the urban square[2].



VERONA:

I. Piazza d'Erbe

VERONA: Piazza Erbe

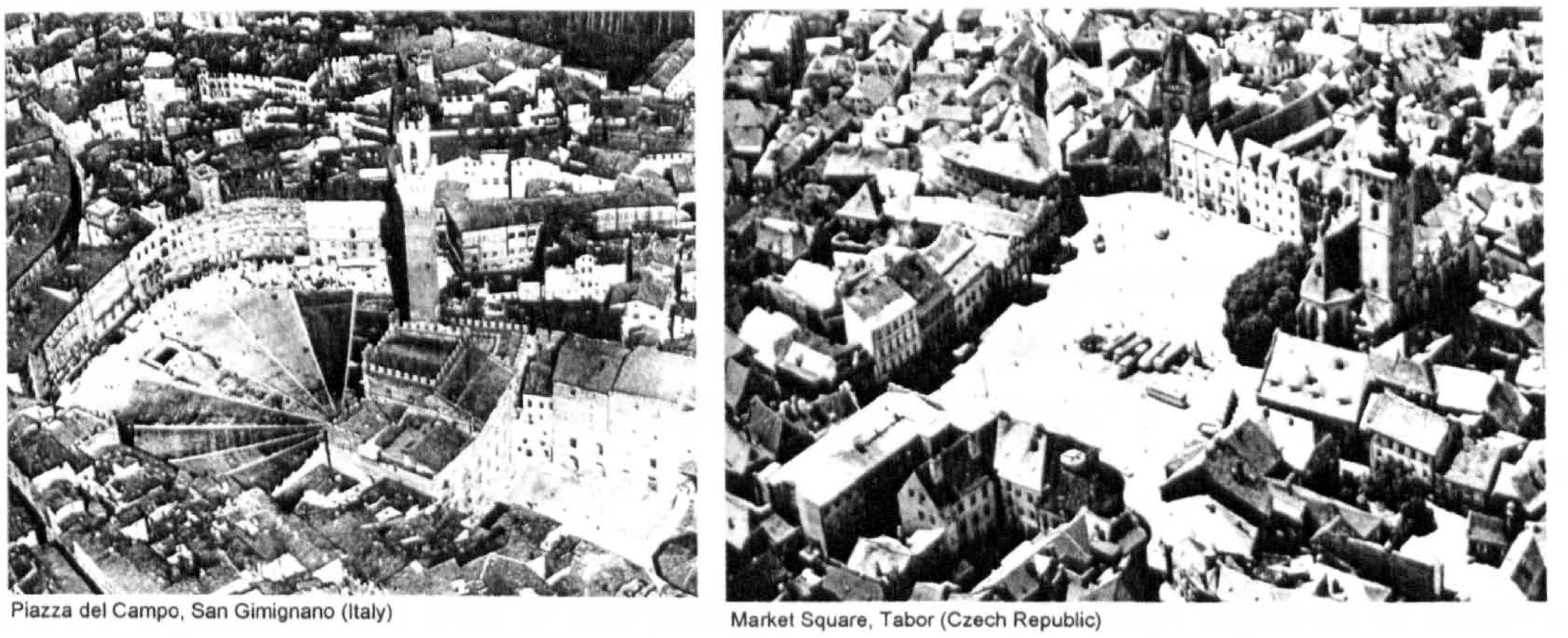
Figure 2.2. Example of the irregularity property
Sitte, 1889

In addition, according to Sitte, irregularity makes it easier to place statues or monuments in indentation or recessed areas. Sitte (when discussing XIX Century examples) adds that regularity can exist in so far as the streets approach the urban square creating a sense of enclosure as defined previously.

Finally, Sitte makes some attempt to analyse the area of urban squares, mainly because their size can contribute to a positive or negative experience. Although he does not arrive at any conclusions, he suggests that the average size found empirically (by measuring plans of what he calls "great squares" in traditional cities) was 57 by 143 metres, he infers that people are reluctant to cross a wide square, while smaller squares can provide a "feeling of comfortable snugness" (Ibid., p28). Figure 2.3 illustrates the enclosure property achieved by access streets whose angles lead visually to blank façades. The irregular property of the asymmetrical placement of the buildings surrounding the urban square may be seen in the two examples that still preserve their original morphological characteristics today.

---

2 A likely contemporary and positive interpretation of unexpected views is the "serial vision" as described by Cullen (1961). Cullen illustrates the different and contrasting views faced by a pedestrian when walking in an urban environment richly composed of the "irregular" placement of buildings and artistic elements. "The slightest deviation in alignment and quite small variations in projections or setbacks on the plan have a disproportionally powerful effect in the third dimension" (Cullen, op cit., p17).



Piazza del Campo, San Gimignano (Italy)

Market Square, Tabor (Czech Republic)

Figure 2.3. Examples of traditional urban squares
Morris, 1994

Like Sitte, Unwin's (1909) views on urban design led him to investigate the morphology of urban squares. Unwin believes that public squares act as important reference points in the structure of cites, a phenomenon found in medieval towns. They are important because they can help the population to grasp the city layout. Unwin believes that it is important to give meaning to different parts of a city, to emphasise some parts and to subordinate others. This can be achieved by creating centres and sub-centres focusing on central squares with the grouping of important public buildings since, if the buildings are scattered around town, they will lack identity. He points out that for an urban square to become a "genuine centre where people are likely to congregate" (Unwin, op.cit., p187), which is his criteria for measuring the success of urban squares, an important aspect is to be at the focal point of main traffic lines, or very near to those points, to avoid the danger of being deserted and therefore deleterious spaces. Here, Unwin makes an important remark concerning the points to be explored in this thesis. Unwin is one of the first authors to notice that the location of urban squares in the urban fabric, which he refers to by lines of traffic, is important for their performance.

When discussing the importance and morphology of public squares to be successful, Unwin's work has many similarities with Sitte's work. Unwin investigates a number of traditional medieval squares in Europe and concludes that enclosure was a common morphological property. He believes that enclosure is fundamental because it not only gives a sense of completeness and repose to the place itself but also provides a proper frame and background to public buildings. For Unwin, a complete sense of enclosure is not necessarily a result of a continuous frame of buildings. In fact, the enclosure effect achieved by traditional squares is the result of how streets enter an urban square, in so far as from the entry point where someone will be standing, they do not get an extended view of another street and are not therefore breaking the line of buildings. He points out:

> "In many cases, the line of streets is slightly broken at the junctions, the continuation of the opposite side of the road not exactly opposite to the previous line of the road. In this way, many of the street vistas would be closed by buildings."
>
> (Unwin, 1909, p60)

This, he argues, is the kind of morphology found in the urban squares of medieval towns: "being a result of conscious design or the product of a more or less unconscious instinct, we must admit the beauty of the effects produced and the success of the whole" (Ibid., p219). Unwin comments on an important property already mentioned by Sitte, regarding space layout artifices which help to achieve the sense of enclosure by the use of "broken vistas". Figure 2.4a, because of the strategic positioning of the church building, by any of entry points (A, E and J) the observer, when walking towards the "church square", is faced with a blank façade as illustrated in Figures 2.4b, 2.4c and 2.4d.

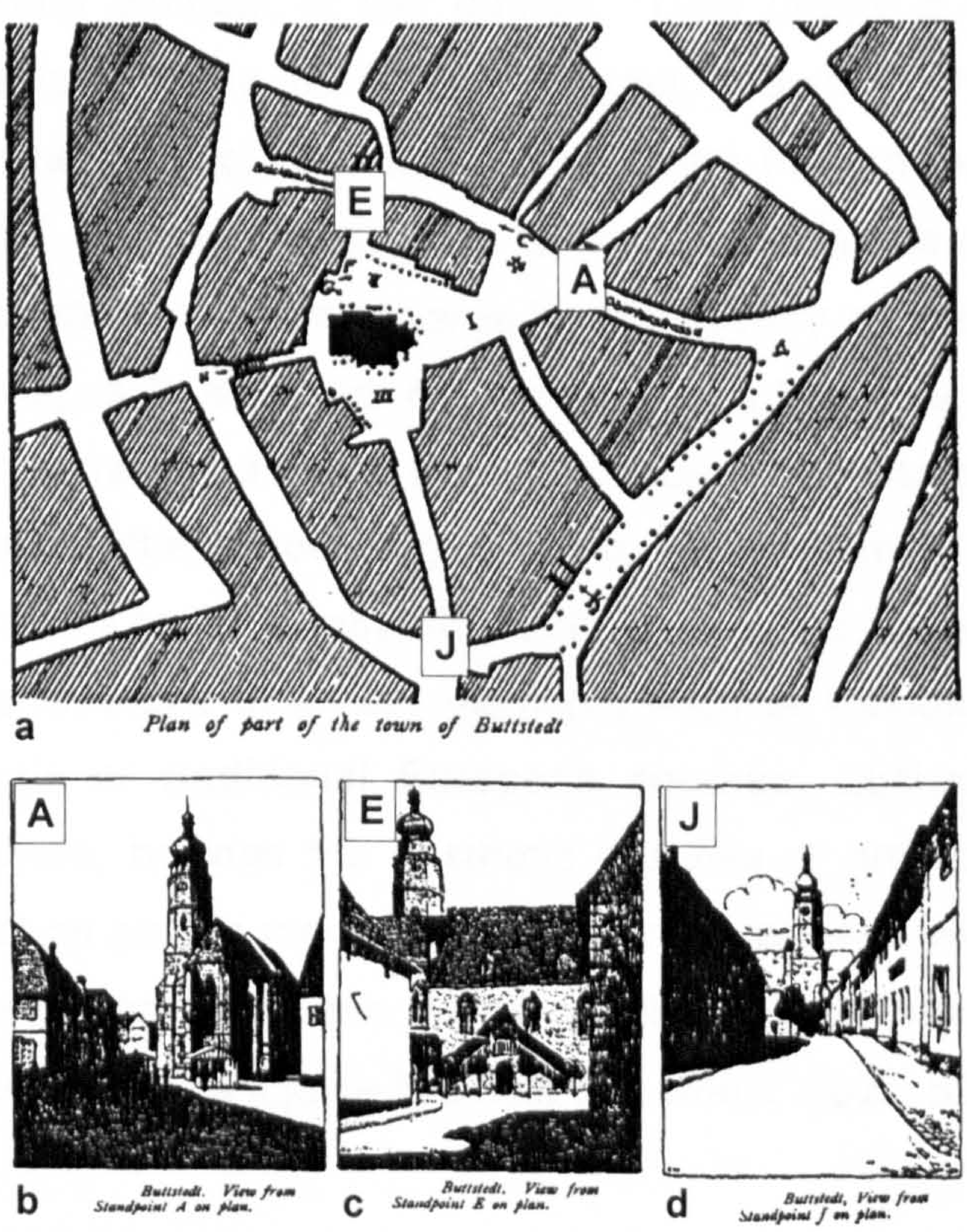


Figure 2.4. Example of broken vistas
Unwin, 1909

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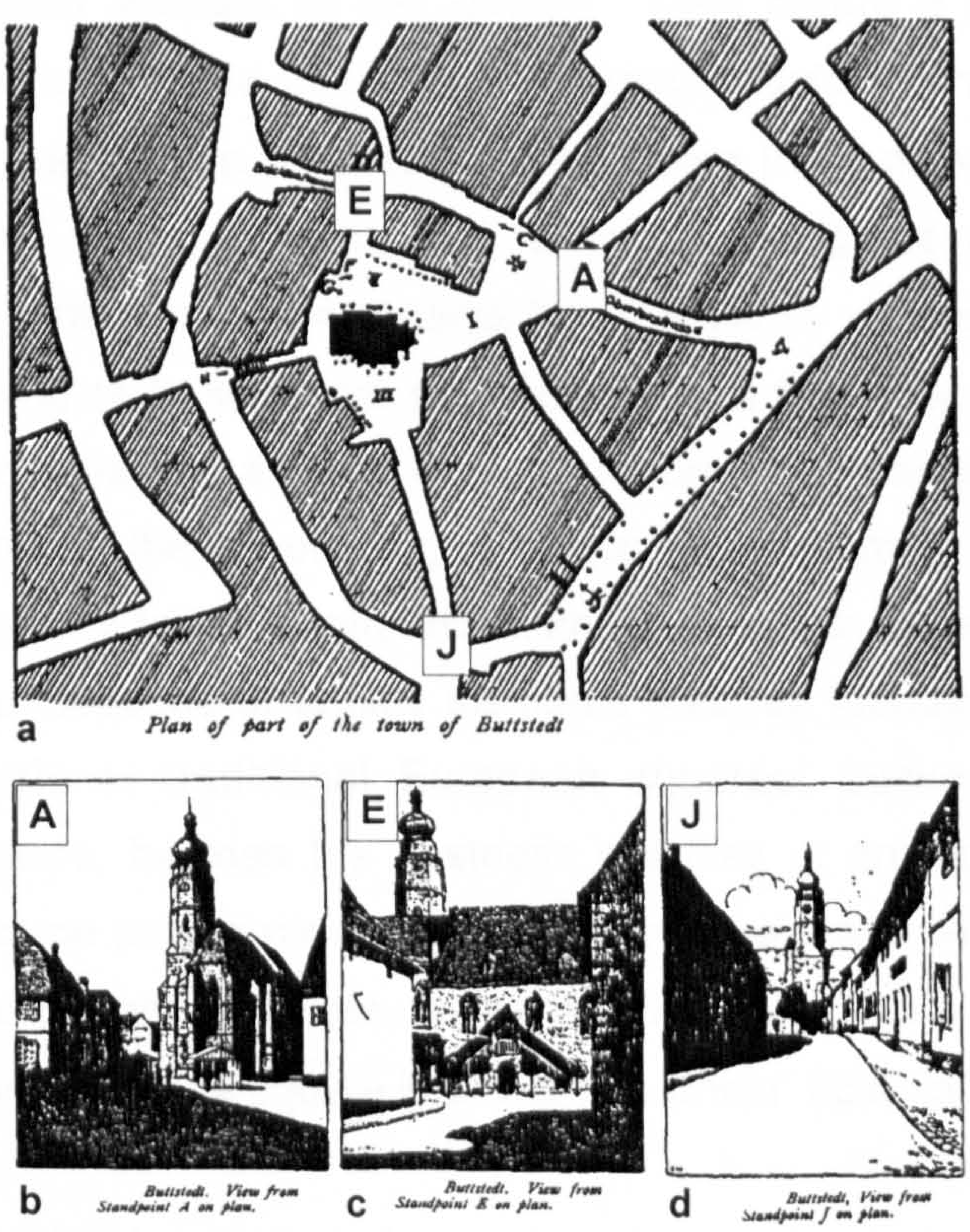


Figure 2.4. Example of broken vistas
Unwin, 1909

Unwin also discusses "irregularity", meaning the lack of symmetry of surrounding buildings. He concludes that although it is a common characteristic of traditional urban squares, the importance of irregularity relies on the fact that it contributes to achieving the enclosure property discussed previously. Unwin criticises the irregular shapes of early XX Century examples without adequate reason, suggesting that the same effect can be achieved with more regular shapes. With regard to the size of squares, Unwin argues that it is important that they are the right size. If too small, they will not help people to orient themselves as urban squares should be in a proper scale to dominate an area. On the other hand, the urban space must also be in proportion to the size of the surrounding buildings so they can be properly appreciated and not seen as isolated entities, although there are no mathematical rules about size and proportions. Finally, Unwin adds that besides enclosure, long vistas from and to the squares are important because they can help the population to have a glimpse, even from a long distance, of the public areas. Again, here Unwin identifies another property that, although not fully explored, will be suggested in this research as an important property for the performance of urban squares.

Zucker (1959), as an historian, focuses on the analysis of public squares as an important element of city design: "They create a gathering place for the people, humanizing them by human contact, providing them with a shelter against the haphazard traffic, and freeing them from the tension of rushing through the web of streets" (Zucker, op.cit., p1). Zucker investigates aspects of the morphology and development of urban squares through history and defines "squares" in relation to city planning as "a structural organization as a frame for human activities" (Ibid., p3). The public square is a result of its enclosure characteristics, that is, the relation between the form of the surrounding buildings, their uniformity and variety, their dimensions and proportions to the length and width of the public square; the angle of entry streets; and to the locations of artistic elements such as fountains or monuments. Based on his analysis of traditional European squares, Zucker suggests that the degree of enclosure, besides the aesthetic qualities of artistic elements, will have a different impact on people moving in the urban square and will therefore define how space will be perceived by people. As he recalls, "specific visual and kinaesthetic relations will decide whether a square is a hole or a whole" (Ibid., p3).

Although this research does not explore typological classifications, they emerge in the work of most authors involved with the studies of urban squares. Zucker points out that there are definite types of squares, which appear repeatedly through history, but the spatial function of a square never automatically produces a definitive spatial form. Each function of a square, such as a market, for example, can be expressed in many different shapes. Zucker adds that it is difficult to give exact dates as to when individual squares developed the form which they present nowadays because spatial changes such as areas or framing structures occurred over the course of centuries. This idea is also shared by Kostof (1992) who, in his own attempt to create a typological classification of urban squares, claims that "any attempt to classify squares will have to rely on form, or on use, but never on both. The reason is simple: squares that fulfil the same or similar functions through history do not by and large take on the same or similar forms" (Kostof, op.cit., p144). Kostof adds that a typological classification based on use is in fact questionable because not only do squares have multiple uses but these uses might also change over time. Hence, the only way to classify them, as suggested by Kostof is his propose classification, is through form (Ibid., p149). Krier (1979) adopts a similar criterion when he creates a typological classification according to the geometric pattern of their ground plans. Sitte also suggests a typological classification, deep and wide squares, based on the relationship between the observer and the character of the dominant building[3].

Zucker's emphasis on the enclosure agents reflects his proposed typological classification of urban squares. According to him, because general morphological structures of urban squares cannot be associated either with specific functions or with a precise position in history, the only way to classify urban squares is by how the space in the square is composed according to what could be said to be levels of enclosure, the presence and location of important buildings (that is, religious and public buildings) and artistic elements. In this sense, Zucker proposes a typological classification which is ultimately what he uses to characterise the morphology of medieval town squares[4]. Unfortunately, Zucker's work, although it is extensive and popular with other academics who are interested in the design of urban squares, is not capable of analytic interpretation for the requirements of the performance of urban squares. Zucker devotes the majority of his work to a study of urban squares through

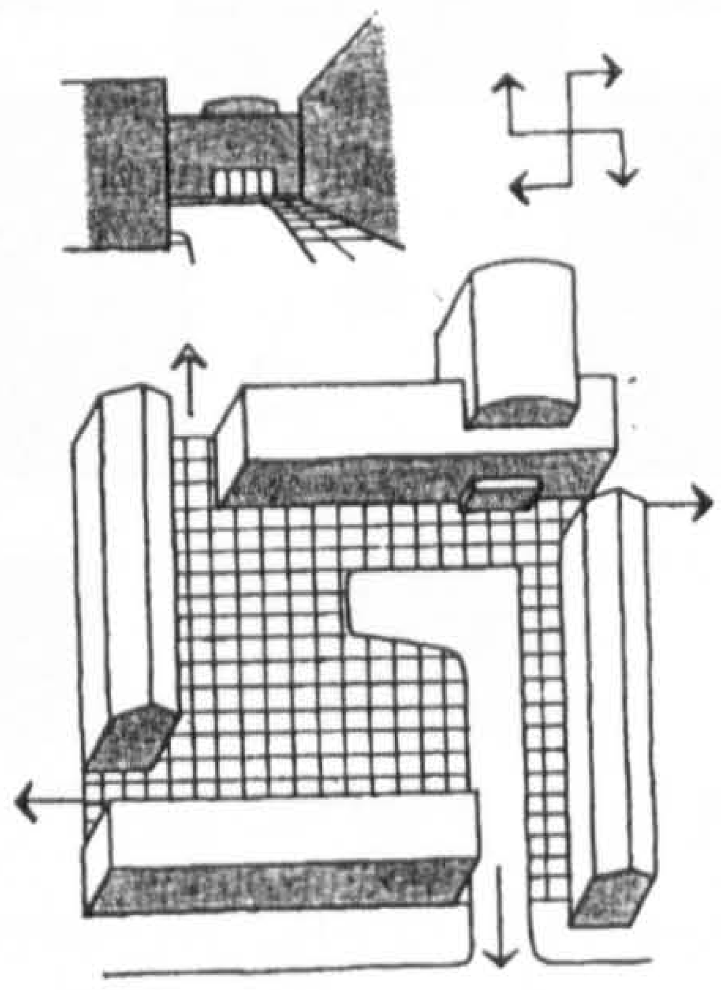
[3] There exist some classifications based on function as in the work of Hettiarachchie (1987) or Önal (1994) (although specifically on public squares in "Turkiye"). Francis (1987b), Marcus and Francis (1990) and Carr et al. (1995) also develop typological classifications not based in either function or form but on the use and importance in American life of what they denominate as innovative or contemporary urban public spaces.

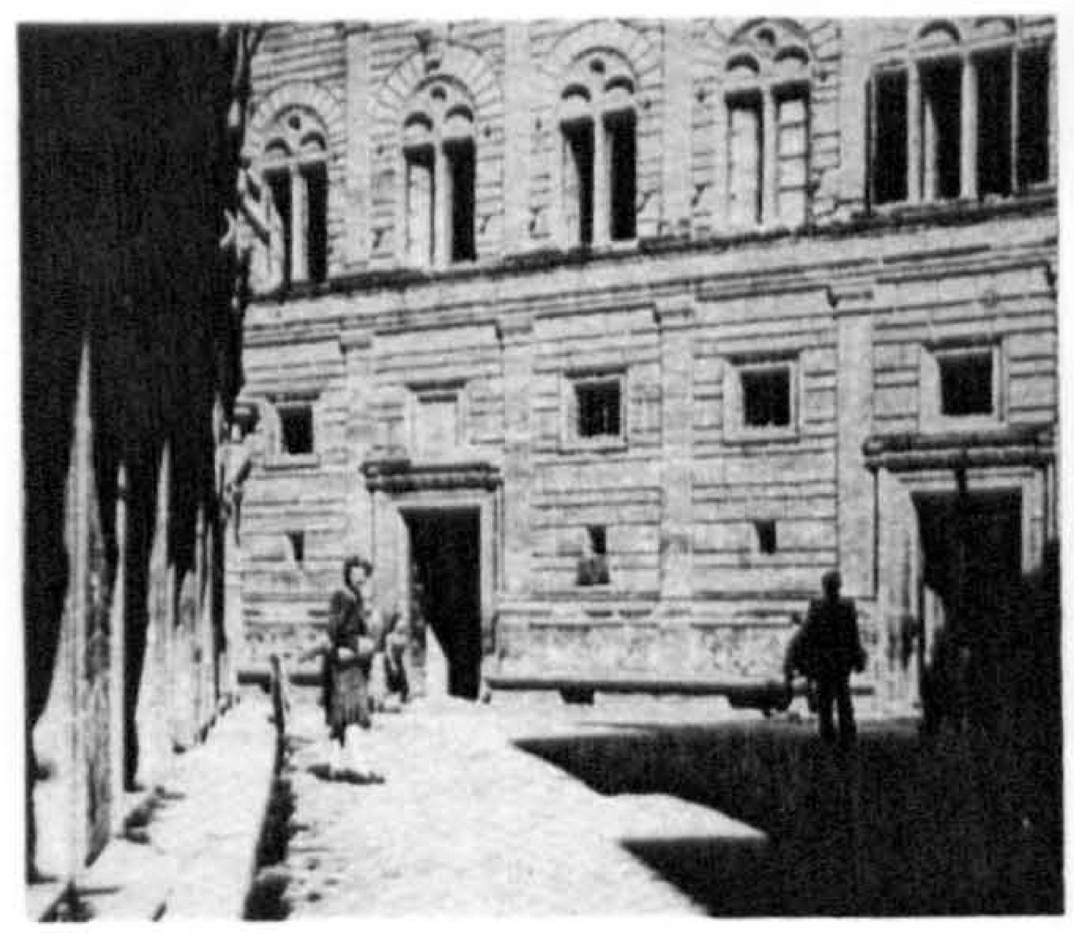
[4] The public squares are classified as: closed, dominated, nuclear, grouped, or amorphous. See Zucker, 1959, p9.

history through his typological classification, and he is inconclusive when analysing properties for the performance of urban squares. Enclosure is seen as an important element for how the space is perceived by people, but not necessarily as a relevant element for producing good or bad urban squares.

Gibberd (1967) is another author who due to his interests in the design of cities, dedicated his attention to the design of urban squares, and in particular to what he referred to as the "civic spaces" (Gibberd, op.cit., p95). Gibberd stresses, "the most essential characteristic of town design is the combination of different objects into a new design; the designer must consider not just the design of the object itself, but its co-relation with other objects" (Ibid., p11). He adds that, when designing the spaces of our towns, we need to think of them as a series of changing compositions which, although having an overall continuity and coherence, sustain and excite our interest by contrast and surprise. Gibberd looks at examples of successful traditional medieval squares in order to understand the devices used at the time to produce coherent spaces, focusing on ideas of the composition of spatial elements. He draws constant parallels between traditional and contemporary examples. Specifically, to achieve the spatial enclosure property, according to Gibberd, civic spaces, which are spaces which the population use to congregate, "the chief meeting place for the inhabitants, the place towards which they will naturally gravitate" (Ibid., 95), should be surrounded by important civic buildings, like the town hall, but not exclusively. Other buildings, like shops or museums, should also be added because buildings for different uses will generate a varied and continuous activity in the space and also avoid what he calls "the danger that the rest of the centre may become rather dull through being denuded of all buildings of a monumental character" (Ibid., p97).

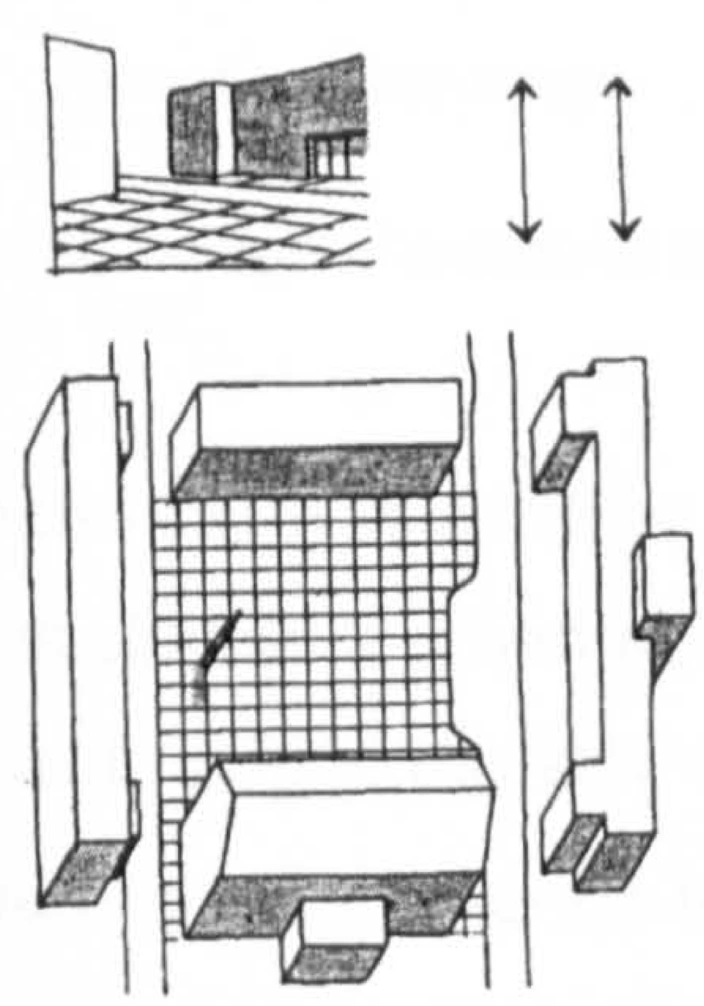
Specifically concerning the morphological aspects of urban squares, Gibberd gives much attention to the juxtaposition of buildings, entry points and vistas and how, with a careful composition of masses, it is possible to achieve the results of enclosed spaces previously achieved in traditional mediaeval squares. Gibberd makes constant comparisons with medieval public squares to highlight the solutions used at the time to achieve the enclosure property, even thought physically the buildings were not framed together. Gibberd, like Sitte, concludes that the arrangement of the buildings composing the urban square to suggest spatial enclosure could be achieved by similar façades. However, the most important criterion to achieve the enclosure character, is the relationship between masses and corner. Gibberd argues that in order to bring buildings together to form a space for civic use, the greater the similarity between the façades of adjacent buildings, and the fewer the gaps between them, the greater will be the sense of spatial enclosure. He concludes that, whenever possible, from the entry point the observer should see a building façade (Fig. 2.5), even if the enclosing element is further back beyond the façades of the buildings surrounding the urban square, as shown in Figure 2.6.

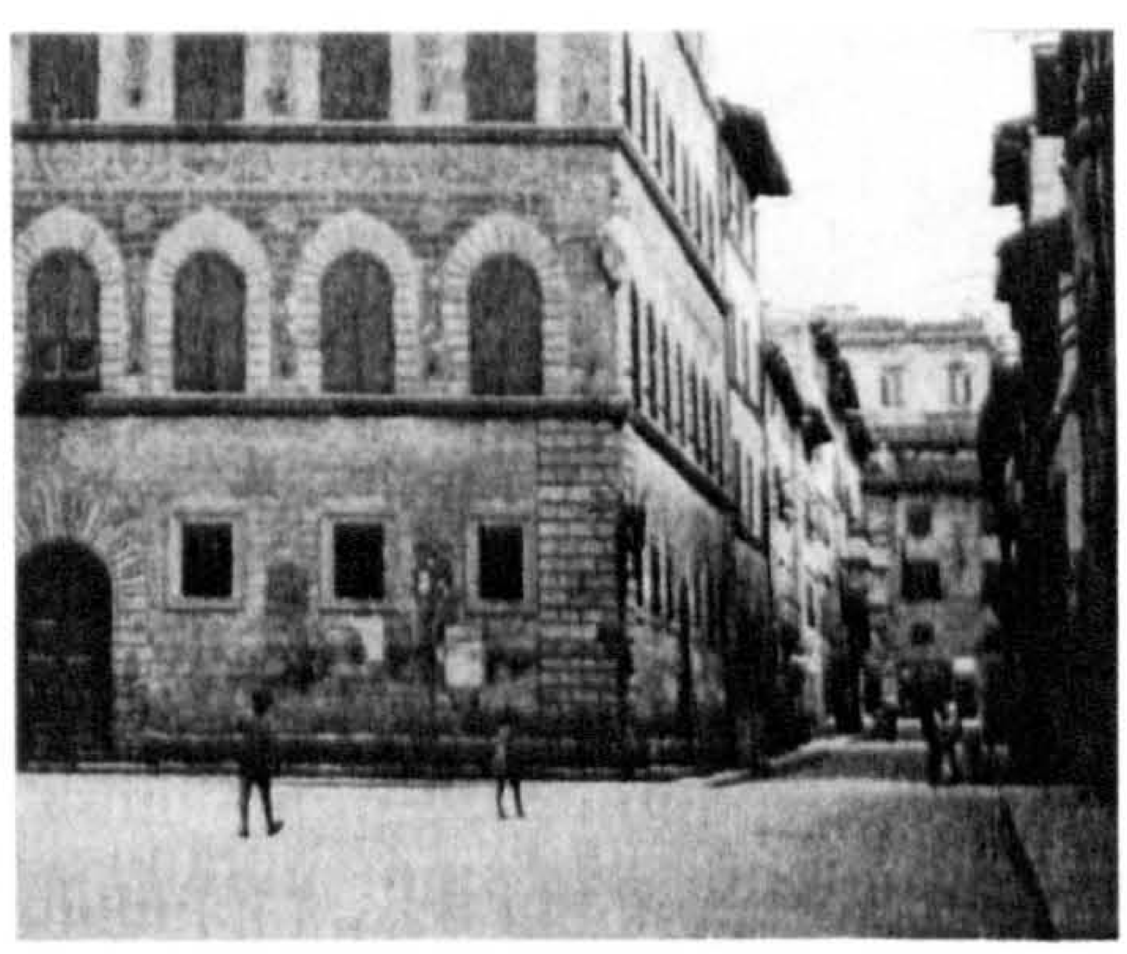




Rome, Pal. Rucellai

Figure 2.5. Example of the juxtaposition of buildings
Gibberd, 1967





Florence, Pal. Guadagni

Figure 2.6. Example of enclosing elements outside an urban square
Gibberd, 1967

Gibberd goes on to discuss when, due to modern constraints such solutions cannot be applied, how a series of devices, such as the use of arcades[5], might achieve spatial enclosure (Fig. 2.7) visually framing the buildings in one element. Gibberd goes on to discuss how the placement of important buildings, which typically occurs in civic spaces, could emphasise the building space associated with a principal building and

[5] Classical examples are the French towns of Montpazier and Villeneuve-sur-Lot. Refer to Gibberd, 1967, p112. In fact, here Gibberd is endorsing Sitte's ideas on how to achieve a spatial unit with the use of arches and colonnades.

also achieve a good result through a coherent enclosed composition. Again Gibberd draws many parallels to mediaeval church squares, with the use of devices such as projections and recessions of the main building in respect to the other elements of the urban square.

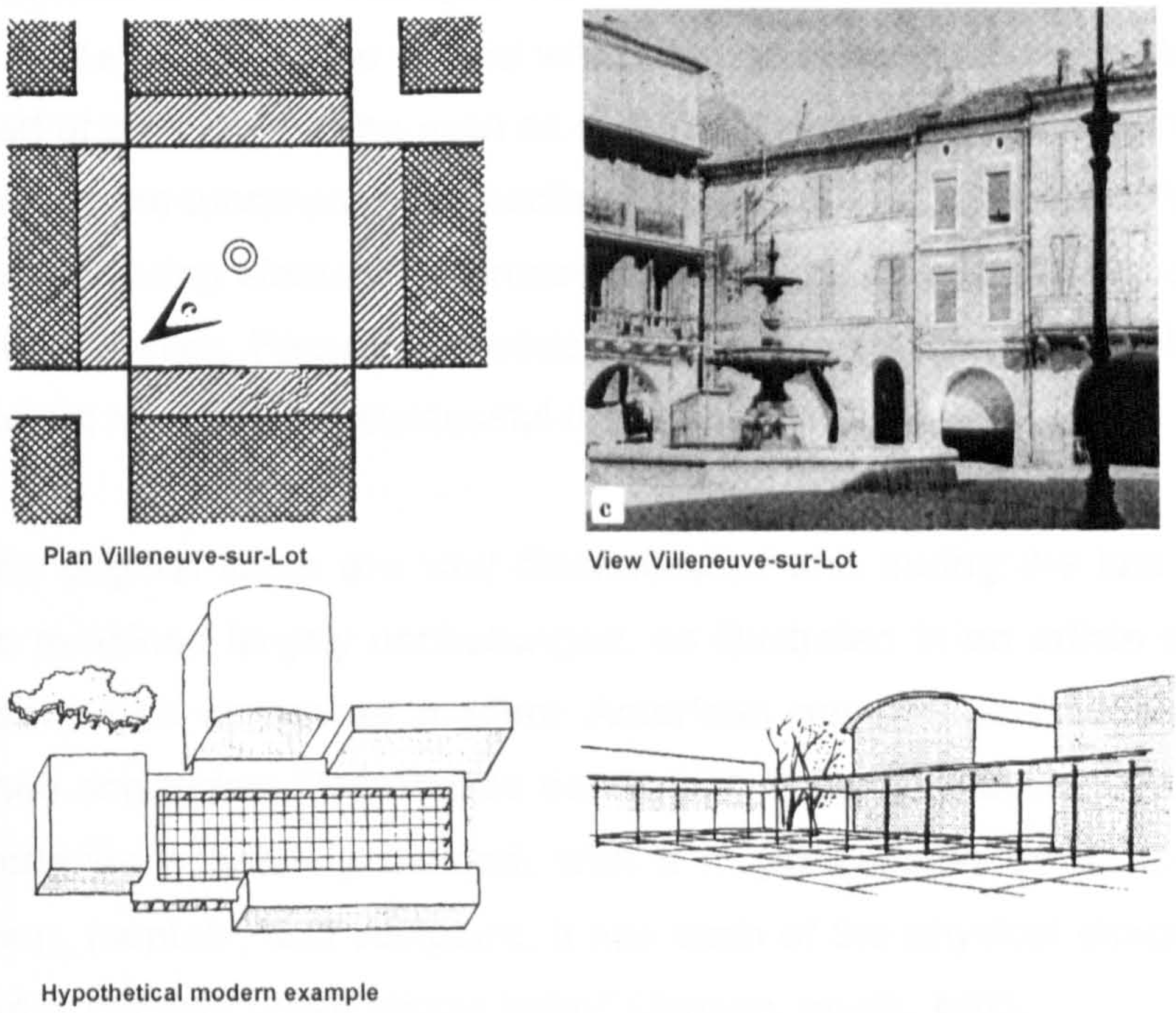


Figure 2.7. Example of arcades as spatial enclosure elements
Gibberd, 1967

French (1978) is another historian whose work focuses on an analysis of the nature and evolution of urban squares, highlighting the role of public squares as an important element for good quality city life. In his study on the morphology of urban squares in Eastern society, French tries to identify morphological differences between periods[6]. He also argues that enclosure is important because it also relates to feelings of protection, intimacy and scale and creates a sense of well being and comfort which is determined by what he calls the primary and secondary enclosing agents. The primary elements are the fountains or any decorative elements combined with the secondary ones, that is, the external enclosure elements such as buildings. The quality of an urban square relies on the mass to space ratio composing the external enclosing space in addition to a precise detailing and placement of primary enclosing agents

[6] French divides his analysis into classic, medieval, renaissance and industrial periods (French, op.cit., p28).

(French, op.cit., p8). French uses this criterion to suggest a typological classification[7] which, similarly to Zucker, he adopts to characterise the morphology of urban squares. French adds that the limitation of form is due to natural conditions, like topography or climate, and behavioural characteristics, like political or religious aspects. The final determination of form emerges from the outer enclosing agents, that is, buildings, and the inner structure of the square which can be either an isolated element like a fountain or part of a major building such as a church tower (Ibid., p23). In this sense, specifically regarding the morphology of medieval urban squares, French highlights the irregularity of the enclosing elements expressed primarily by off-set wall planes and acute angles; but like Zucker, French is inconclusive regarding the spatial elements that can be important for achieving successful urban squares.

Sitte's original ideas are well disseminated and during the last hundred years they have remained largely unchallenged, as illustrated in an article published in 1981 by Jensen, who compares modern American squares to traditional European ones. Jensen concludes: "The Piazza del Campo is the quintessential urban space. With its boundaries absolutely defined, with a major building as its focus, with its paving pattern, fountain, and sculpture, it has each of the physical characteristics we wish to affirm in our own urban plazas today" (Jensen, op.cit., p52).

Taking a similar approach, Moughtin[8] (1992) studied public squares as one of the three principles of the composition of the built form; the other two are buildings and streets. He also states, like Gibberd, that the most successful city squares are often the ones that sustain activities through a diversity of uses in the surrounding buildings (Moughtin, op.cit., p88). Moughtin also makes an analogy between public squares and "outdoor" rooms, and claims that enclosure is the purest expression of a sense of place (Ibid., p99). The key to enclosure is the treatment of its corners. Moughtin suggests that the more open the corners of the square, the less the sense of enclosure, the more built up and complete they are, the greater the feeling of being enclosed. Moughtin, by examining a vast number of traditional examples from European cities, also claims that the height of the enclosing buildings in relation to the size of the space, the presence or absence of an unifying architectural theme, variety of spatial

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[7] The classification is derived from outer enclosed agents and the inner structure of the square. They are characterised as centric or enclosed. See French, 1978, pp20-32.

[8] Webb (1990) is another scholar who has investigated a series of traditional historical squares and also concluded that enclosure is an important feature for the good performance of public spaces. To a lesser extent, refer also to Bacon, 1967.

composition and the overall shape of the space itself are also important components to create the enclosure character of the urban square[9].

While Sitte and other authors analysed the morphology of public spaces by examining a number of traditional "famous" examples from European cities, their work was based exclusively on information obtained from historians without empirical evidence to support claims as to how successful the public spaces were. Also, none of the authors who focused on the morphological analysis of traditional urban squares investigated or discussed spatial properties in their morphology regarding the visual and permeability connections with the urban fabric and possible implications to levels of pedestrian movement and static occupancy. Unwin (1909) and Gibberd (1967) do stress the importance for urban squares being close to areas with high levels of pedestrian movement as an important issue for their success, but not necessary a property found in their study of traditional squares. In the next section, an alternative approach is introduced whereby the bulk of the findings of the research work is based on empirical evidence taken from modern, purpose-built XX Century public spaces generally with the aim of producing design guidelines.

2.2. EMPIRICAL STUDIES OF CONTEMPORARY PUBLIC SPACES

Greenbie (1981), who studied the relationship between social behaviour and urban environment claims that the "surprise effect" is the most important factor to avoid empty "urban squares"[10]. An urban square should be designed for human action and interaction to attract people and therefore to be lively, by means of spatial theatricality achieved by elaborate internal spatial layout, where the composition and architectural styles of buildings surrounding the urban squares are all important factors.

The concept of theatricality is further discussed in the work of Lennard and Lennard (1984, 1987 and 1995). Lennard and Lennard, by comparing the levels of static

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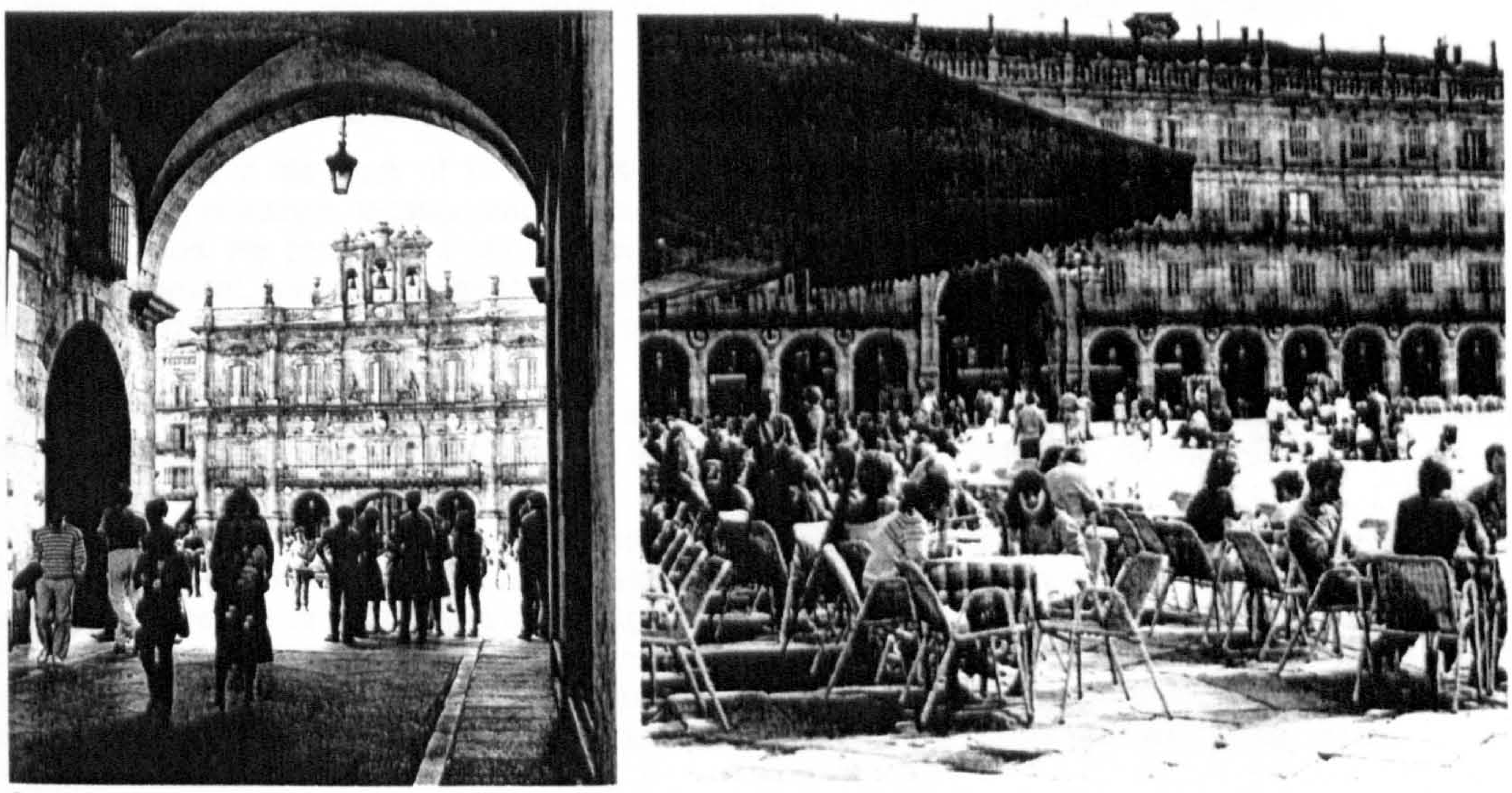
9 Like others, Moughtin also discusses a typological classification identified through the surrounding element composition.

10 "Urban squares" is the terminology employed by Greenbie. Later in this section other terms are employed like "urban space" (Lennard and Lennard, 1984, 1987, 1995).

occupancy of people in examples of traditional and modern urban spaces[11], maintain that in the most successful cases one finds a series of spatial elements that help to transform an "open space" (implying an unsuccessful space) into a theatre set and therefore a successful "urban space". These elements are the concealed entrances beneath arcades, also referred as the "threshold experience" (Fig. 2.8) leading to visually enclosed spaces, the presence of dominant buildings surrounding the space which act as theatrical backdrops, fountains, statues and adequate seating areas that can work as part of the theatre settings. All these elements might fulfil the necessity of developing different activities by different users, and might not only attract tourists but also the general population who would use the urban square as an integral element of their daily social life. The next passage illustrates this concept:

> "Salamanca Plaza Mayor is one of the world's liveliest and most successful urban spaces, successful not merely for tourists but for the local residents...the entrance into Plaza Mayor is designed to heighten the experience of entering. The entrance is narrow, dark, arched, offering a glimpse and suddenly, in stepping across the threshold one is in...outdoor room filled with people. The surrounding...buildings with their continuous iron balconies creates a vast theatrical stage set...The visual enclosure gives the sensation of having arrived at a destination, of needing to go no further, of belonging."
>
> (Lennard and Lennard, 1987, p42).



Salamanca (Spain)

Figure 2.8. Example of threshold experience and surprise effect
Lennard and Lennard, 1987

[11] Apart from photographs, there is no hard evidence on the actual levels of static people occupancy.

This interpretation suggests that the more the urban space provides the design elements for a range of actives and experiences required by people, the more successful it is likely to be because not only will more people use the space for informal unprogrammed static activities, but they will also stay for longer. The under-used urban spaces are the ones that ultimately fail to satisfy their users (Francis et al., 1984). It is a matter of identifying what social functions and social experiences are expected to occur in urban spaces and deliver the appropriate solutions. This concept has produced a number of similar studies, which often propose checklists and guidelines as seen in the work of Hettiarachchie (1987)[12], Marcus and Francis (1990)[13], and Lennard and Lennard (1987 and 1995). This type of analysis is illustrated in the work of Lennard and Lennard (1987) who, after compiling a list of social functions and social experiences[14], produce a list of design principles and recommendations, summarised in ten points:

1. Urban spaces should be free from vehicular traffic. Instead, a pedestrian network should be created in so far as it facilitates access to public spaces, and hence the participation of all segments of society, such as the elderly, handicapped and children.
2. Urban spaces should be located at the heart of the city or neighbourhood as they fulfil both functional and symbolic roles but they must also be multifunctional, accommodating as many uses and activities as possible.
3. The size of the urban space[15] and the surrounding buildings should be scaled down to human proportions and human use to facilitate social interaction.

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[12] Hettiarachchie in his study of 12 squares in Rome, Helsinki and Colombo suggests that the beauty of the surrounding buildings, location and creation of activities, are all relevant attributes for attracting people to public spaces. He produces a checklist where he makes recommendations concerning location in the urban environment, size, scale, treatment of the walls of the surrounding buildings, location and type of decorative element, lighting and provision of public services.

[13] Marcus and Francis's design principles are very similar to the ten points highlighted by Lennard and Lennard (1987) as described in the text. See Marcus and Francis, 1990, pp6, 18 and 19.

[14] The social functions and experiences identified by Lennard and Lennard (1987) are: Facilitate all members of community safe and easy access, to facilitate frequent and regular use, to make people feel significant and reinforce their sense of belonging, to increase awareness and enjoyment of the moment, to encourage curiosity, interest and exploration, to frame meaningful and memorable experiences, to orient and facilitate different activities, to make people feel at home, to amplify channels for direct interpersonal communication with eye contact, voice and face recognition (Lennard and Lennard, op.cit., p10).

[15] Like Sitte (refer to Section 2.1) who suggested an ideal size for the good performance of urban squares, many contemporary authors have produced detailed analyses with quite different conclusions regarding their optimal size. Alexander et al. (1977) recommends that public squares should be between 13.7 to 18.3 metres across, Lynch (1971) suggests up to 24.5 metres and Gehl (1980a) proposes a maximum dimension of 70 to 100 metres. Lennard and Lennard (1987) recommend that the optimal size should be related to the social life that takes place, accommodating the busiest regular daily or weekly events.

4. Visual enclosure and the threshold experience foster a sense of belonging.
5. Public spaces should have natural elements, that is, plants, flowers and trees, as they increase sensual experiences and can be used as places to linger or shelter.
6. The intricacy and variety of surrounding buildings with unpredictable changes of view[16] stimulate curiosity and interest in the setting and encourage exploration.
7. Intimate and personal territory adjacent to significant and historical buildings gives structure to meaningful experience and crystallise memories.
8. Architectural backdrops, changes of floor levels, floor textures, bollards, and focal points such as fountains, orient people in space since different parts of the public space will have defined personalities and will therefore facilitate a differentiated use of space.
9. Public spaces should also have appropriately designed seating, ledges, walls, planters, rails, and steps for people of every age and ability.
10. The orientation and dimensions of seating arrangements should permit eye contact, facial and voice recognition to facilitate interpersonal contact and communication amongst users.

(Summarised from Lennard and Lennard, 1987, pp10-37)

For each of the points, Lennard and Lennard made recommendations. For instance, with reference to the first point on public spaces being free from vehicular traffic, pedestrian zones should be introduced with a network of pedestrian streets and squares that could work as "nodes"[17]. Also, in the city centres, entire areas should be pedestrianized as in the old historical core of many European cities.

In addition, several negative factors such as age and lack of maintenance are often mentioned (Miles et al., 1978; Gehl, 1987). Burden (1977) adds that good maintenance is an essential feature contributing to the success of public spaces, as is the presence of concessions such as a sandwich stand, which is also suggested in the research of Nasar and Yurdakul (1990). In Burden's study examining the relationship between static use and design features for a small public space in New York, USA (Greenacre Park), he claims that over half the people who enter the park go directly to the concession (Burden, op.cit, p37). Likewise, Francis (1987b) calls attention to safety

[16] What could be translated as Sitte's irregularity property.

[17] From Lynch, 1992.

and security, as safety is the most frequently reported barrier to people's use of public spaces[18].

Francis (1987b) also mentions comfort and perception as important issues for the achievement of successful public spaces. Comfort involves not only adequate sitting facilities, but also protection from wind and rain. Although in this PhD thesis the effect of different weather conditions in patterns of spatial use of public spaces is not investigated, but held constant as much as possible during the data collection period, it is accepted that weather can be a significant factor in the number and distribution of static occupation.

Bosselman (et al. 1984 and 1987) studies the effect of wind and shade as a by-product of high rise buildings in a number of public squares in San Francisco re-created under laboratory conditions. He concludes that in downtown San Francisco, although the wind only occasionally produces conditions that are too severe to cause discomfort for users, the more windy the place is, the higher the temperature needed to maintain a comfortable situation. He gives an example: "in downtown San Francisco, where [on] all but the warmest days, parks and plazas [which] are windswept or in shadow are virtually deserted, while those that offer sunlight and protection from the wind are heavily used" (Bosselman et al., 1984, p12), suggesting how his applied methodology[19] could be used when allocating seating areas. These findings are also mentioned by Burden (1977) who claims from observations studies that the sun can become an important factor in the coolest months, affecting where people sit and for how long. Miles et al. (1978) also from a study of use patterns of public spaces in Seattle (USA), maintains that shade and strong winds produced by tall buildings are a negative factor[20].

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[18] According to Nager and Wentworth in a study of Bryant Park in New York. See Nager, A. and W. Wentworth (1976) *Bryant Park: A Comprehensive Evaluation of its Image and Use with Implications for Urban Space Design*. New York: Center for Human Environments, City University of New York. Quoted by Francis, 1987b, pp89 and 105.

[19] Bosselman calls his methodology the "comfort modelling process" (Bosselman et. al., 1984). He creates a graphical scale on the percentage of time during the day according to seasons and, based on wind and sun conditions, that each area of a public space would permit thermal comfort. He also suggests angled models and cut-off planes for the surrounding building envelopes in order to enhance the amount of sun and lessen the amount of wind inside public spaces.

[20] It is important to point out that although weather conditions can affect levels and distribution of static occupancy inside public spaces, this does not invalidate the results of this research. As will be explained in detail in due course, the public spaces were observed, as much as possible, for static occupancy during the same days, therefore minimising the weather variable. In "a" specific day independently of the weather, the aim is to find out why some public spaces get more people than others.

Research studies on urban space perception and cognition, generally focuses on urban scenes, most notably the roadside environment. Nevertheless it is worth mentioning the findings of studies that most approximate the analysis of public space areas. Im (1984) in a study on the aesthetic visual quality of enclosed urban spaces, concludes that the visual quality of public spaces can be measured by human visual preference based on three variables: positively related to ground and vegetation coverage and negatively related to building height ratio. Herzog (1992), in a study of nine variables for preferences for urban spaces classified in four different categories[21], concludes that "coherence" or "order" (how well the scene hangs together) and "complexity" (how much there is to look at) are positively related to preferences, in opposition to "age" which is negatively related. On the other hand, all the others elements such as "spaciousness" (the feeling of spaciousness the scene conveys); "mystery" (a setting promises that there is more to be seen if someone could walk deeper into it); "refuge" (would involve features that someone could use to hide himself); "legibility" (how easy it is to find your way around the environment); "typicality" (referring to the extent the scene seems to be a representative example of its class); and "enclosure" (the feeling of being enclosed in a hiding place), proved to be irrelevant (Herzog, op.cit., p239). According to Joardar and Neill (1978) in a study of nine public spaces in the USA, complexity, and variety by means of variety in the shape and size of artefacts, texture of surfaces or changes in floor level also counted well for the best scoring plazas. Likewise the presence of water and vegetation were important positive factors. For the poor performing plazas, sparseness and repetition were the reasons for displeasure by means of a lack of focal points, greenery, or the monotony of spatial organisation.

Carr et al. (1995) claim that it is important to examine the needs of both regular and occasional users of public spaces because "places that do not meet people's needs or that serve no important functions for people will be underused and unsuccessful" (Carr et al., op.cit., p92). According to Carr, there are five types of functional reasons that seem to account for people needs in public spaces:

1. Comfort: With the provision of food, shelter from weather conditions and adequate seating.

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21 The public spaces were categorised according to open-undefined (open-flat settings lacking spatial definition), spacious-structured (setting contains elements such as trees or landmarks), enclosed and blocked views (setting contains visual obstruction that prevents visual access. The findings refer to all cases.

2. Relaxation: Separation from vehicular traffic.
3. Passive engagement: Provision of facilities that entertain users such as scheduled and unscheduled events, vegetation, fountains and artistic elements that can provide focal points of interest for contemplation.
4. Active engagement: Provision of features that encourage direct contact amongst users.
5. Discovery: Spatial differentiation with (decorative) elements of surprise or changing vistas.

Carr concludes that functionality on its own does not explain the presence of people in public spaces. To be successful, public spaces also need to embrace other qualities, that is, ease and freedom of access, freedom of action, claim to or differentiated spatial territoriality, change by the ability to adapt spatially to new trends in society and ownership by the public.

These previously mentioned studies often took their evidences by comparing contemporary public spaces to well-known traditional urban squares in a similar approach to Sitte's work. Therefore, it is not a surprise that the above mentioned authors regarded spatial enclosure again as a fundamental spatial property to ensure good levels of static occupancy. Even the studies that focused on contemporary examples have looked only at the relationship between space design and patterns of use, and have not sought to take account of the urban context in which they were embedded. Quite often, the results are scattered, if not superficial, adding little concrete evidence on ways of predicting with confidence patterns of spatial use. The possibility that visual and physical connections between the public spaces and the urban fabric are a key property to ensure a constant flow of pedestrians started to be considered with the work of Whyte, discussed next.

2.3. STUDIES ON THE PERFORMANCE OF PUBLIC SPACES AND LEVELS OF ADJACENT PEDESTRIAN MOVEMENT

Early studies by Burden (1977) had already suggested that location and relationship to the street are paramount for ensuring good levels of use for public spaces. Public spaces should be close to areas of dense activity and they should be easily accessible both visually and physically from the side walk level. Miles et al. (1978) also highlight the fact that the visual and physical connections with the surroundings affect the use of public spaces. However, Whyte (1980, 1988) is the first influential author to start challenging the previous concepts that aesthetics or the internal layout of public spaces were enough to guarantee good levels of static occupancy. Ideas on visual and permeable connections to the urban environment as means of ensuring the creation of usable pedestrian spaces flourished, as supported by Chidister (1988) and Cohn (1989).

Whyte was essentially interested in the empirical functioning of urban spaces and the morphological elements that may play a significant role in their performance. He focuses his work in small urban spaces, many of them designed in the last 50 years, and the physical variables that would work as major factors in attracting people to use an open public space effectively and not merely as a transitional space. Whyte investigated sixteen small public spaces in New York city and the effect of spatial dimensions of urban forms on the use of public open spaces. He examined the possibility of a correlation between a number of variables such as aesthetics, area and shape, number and ergonomics of seating places, weather variables such as sun and wind, presence of concessions, etc., in the way small urban spaces were used. He concluded that there were various degrees of importance amongst the different elements. Some elements proved not to be relevant, such as natural factors (like sun and wind), aesthetics, decorative elements, shape[22], and amount of space and enclosure, although some enclosed spaces provided better protection against wind and natural factors may have played a more prominent role. A few elements showed a higher degree of importance as complementary factors, such as ergonometric of seating places and elements that work as multiplier effect factors like food, retail, and entertainment facilities. However, Whyte concluded that the street was the real key factor. Whyte remarks: "Now we come to the key space for a plaza. It is not on the plaza. It is the street...The relationship to the street is integral, and it is far and away the critical design factor" (Whyte, 1980, p54).

Whyte claims that the two fundamental elements for successful small urban spaces are the density of moving people in the surrounding streets and the degree of easy access

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22 Since 1961, New York City started giving incentive bonuses to developers who added plazas in the design of office buildings. For each square foot of plaza, developers could add 10 square feet of commercial floors over and above the amount normally permitted by zoning. Designers at that time were unsure whether they could get bonuses out of strip areas. Therefore there was some concern by designers whether strip plazas, that is, long and narrow spaces with length more than three times their width would be well used by people. According to Whyte, there was no evidence from his research that the shape of public spaces would have any significance on their overall number of users (Whyte, 1980, p26).

from the urban square to the surrounding streets. Whyte claims: "A good plaza starts at the street corner...one of the best ways to make the most of it is, simply, not to wall it off." He adds: "The area where the street and plaza or open space meet is a key to success or failure. Ideally the transition should be such that it is hard to tell where one ends and the other begins" (Ibid., p57). Whyte mentions the Bryant Park in New York as an example of an unsafe area mainly because, as he believes, it is under-used by the public. He claims that the park has become an unsafe area because it is cut from the street by walls and fences[23] and he adds that if we cannot see in, we cannot see out, meaning that if people do not see a space, they will not use it. In addition to stressing the importance of pedestrian movement in areas around the public space and the implications of enclosure when used to isolate public areas from pedestrians as harmful, he adds that the visual connections are one of the most important morphological elements for creating dynamic public spaces.

On the same methodological line, Gehl (1989) produced a survey of patterns of space use in public spaces in Stroget, Denmark. He notes that the levels of static occupancy of public spaces had dramatically increased over a period of twenty years and all available squares of "good quality" (Gehl, op.cit., p14) were filled to capacity every day. He concludes that the main reasons for determining the quality or usability of each space are closely related to its location in relation to the main pedestrian flows, which had also dramatically increased in the previous twenty years[24], meaning that the static occupancy had increased in direct proportion to the levels of pedestrian movement.

Although Whyte and Gehl relate important aspects of the urban spatial morphology to the performance of open public spaces, there is no agreed quantifiable model that leads to the degree of embedding of the urban square in the urban grid. In fact, this precise account of how the spatial morphology of the urban grid plays a major role in the performance of urban spaces is given by Hillier and colleagues with the theory of natural movement (Hillier et al., 1993a), grounded on the space syntax theoretical framework (Hillier and Hanson, 1984).

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[23] In this respect, Whyte also points out the inadequacy of sunken plazas, which are normally under used because they are not visible from street level.

[24] The surveys were carried out in 1968 and 1986. Gehl also considered that the local climate, spatial qualities, dimensions, and provision of furniture and supporting activities were also equally important. Likewise, Hettiarachchie (1987) also proclaims that "public squares in an urban context should be located in a place which provides maximum visual and physical permeability" (Hettiarachchie, op cit., p87).

2.4. SPACE SYNTAX METHODOLOGY

Hillier and colleagues propose a theory that allows the study of space as an independent entity. Space syntax theory is outlined in a series of articles from the late 70's up to the most relevant one published in 1984: the book *The Social Logic of Space* by Hillier and Hanson. Space syntax theory and techniques[25] allows for the representation, description, quantification and interpretation of the spatial configuration of settlements and buildings, allowing us to correlate spatial elements to social variables, based on the concept of configuration analysis. Configuration analysis involves the representation of the urban grid (or any other system of connected spaces)[26] as a series of spaces and the relation between spaces, where configuration is a concept addressed to the whole of a complex rather than to its parts. "If we define spatial relations as existing when there is any type of link – say adjacency or permeability – between two spaces, then configuration exists when relations between two spaces are changed according to how we relate one or other or both to at least one other space" (Hillier, 1996, p33). A configuration relation is then defined as a relation in so far as it is affected by the simultaneous co-presence of at least a third element, and possibly, all others elements, in a complex (Ibid., p96).

To examine the concept of configuration, lets us consider as an example two adjacent cells with a permeability link between them as illustrated in Figure 2.9(1). These two cells hold a symmetrical spatial relationship between them with reference to each other's access position. Once we add a third space "c" (Fig. 2.9(2)), there are at least two possible scenarios. In the left case, the cell "b" can be accessed from position "a" or "c"; whereas in the right case, "b" can only be accessed from "c" via "a", which is illustrated by the two graphs in Figure 2.9(3) respectively. Therefore, the relation between "a" and "b" is dependent on each one with respect to "c", being symmetric in the left case and asymmetric in the right one.

[25] The concept of space syntax was developed at the Bartlett School of Graduate Studies, University College London, by Prof. Bill Hillier, Dr. Julienne Hanson, and colleagues of the Unit for Architectural Studies.

[26] Although space syntax is being used very successfully to correlate social variables to spatial elements for both buildings and settlements, all further discussion will be restricted to settlements or the urban layout properly speaking. Specifically on buildings, as essential reference, see Hillier and Hanson, 1984; Hillier and Hanson, 1987a; Hillier and Penn, 1991; and Hanson, 1998.

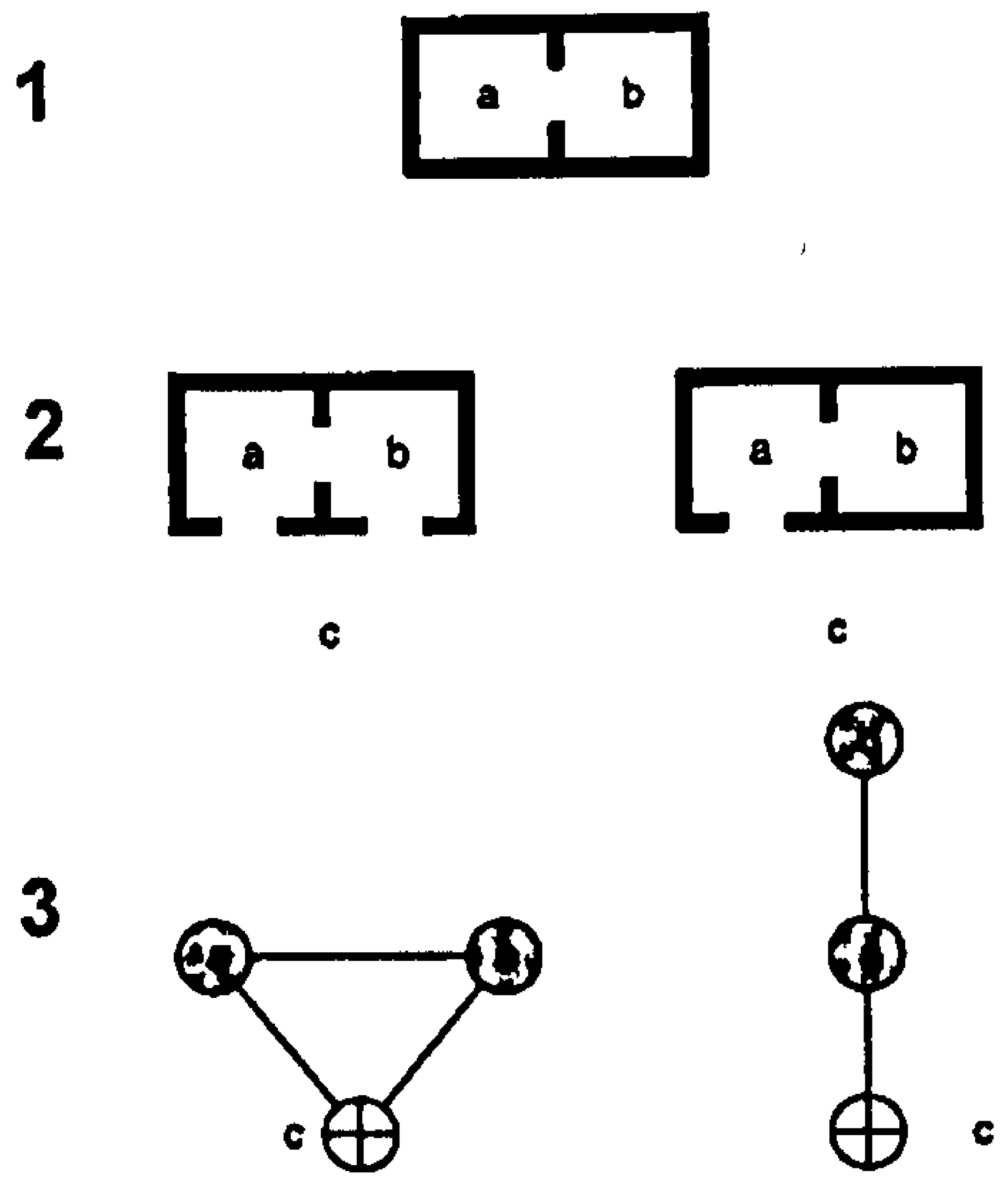

Figure 2.9. Concept of configuration
Hanson, 1998

Comparing both graphs, the left one shows a ring and therefore the possibility of more than one route between spaces, which introduces a second important property of configuration analysis. This is the concept of distributedness—nondistributedness in addition to that of symmetry-asymmetry. A relation is said to be distributed if there is more than one non-intersecting route from "a" to "b". Therefore, examining Fig. 2.9(2), the example on the left holds a symmetric, distributed relationship, whereas in the example on the right, the relationship is said to be asymmetric and non-distributed.

2.4.1. REPRESENTING SPATIAL CONFIGURATION

A common criterion for dividing urban spaces includes their representation as a system of streets and squares. The weakness of such criteria is pointed out by Hanson (1989b). "In all but the clearest cases, it is difficult to decide on shape grounds which category any particular segment of urban space falls into. A wide street, for example, is difficult to differentiate systematically from a small square" (Hanson, op.cit., p69).

Configuration analysis begins with the characterisation of the spatial properties of the urban layout with axial lines representing the one-dimensional organisation, convex spaces, the two-dimensional organisation, and convex isovists, each related to an aspect of how people experience the use of space. The longest and fewest straight lines of visibility and permeability that cover all the open spaces of the urban area define the axial lines. Convex spaces are defined by polygons where no line drawn between any two points in the space goes outside the space[27]. The convex isovist, which in it is not a convex element, is a spatial description defined as the set of all points visible from within the selected convex space as seen in Figure 2.10.

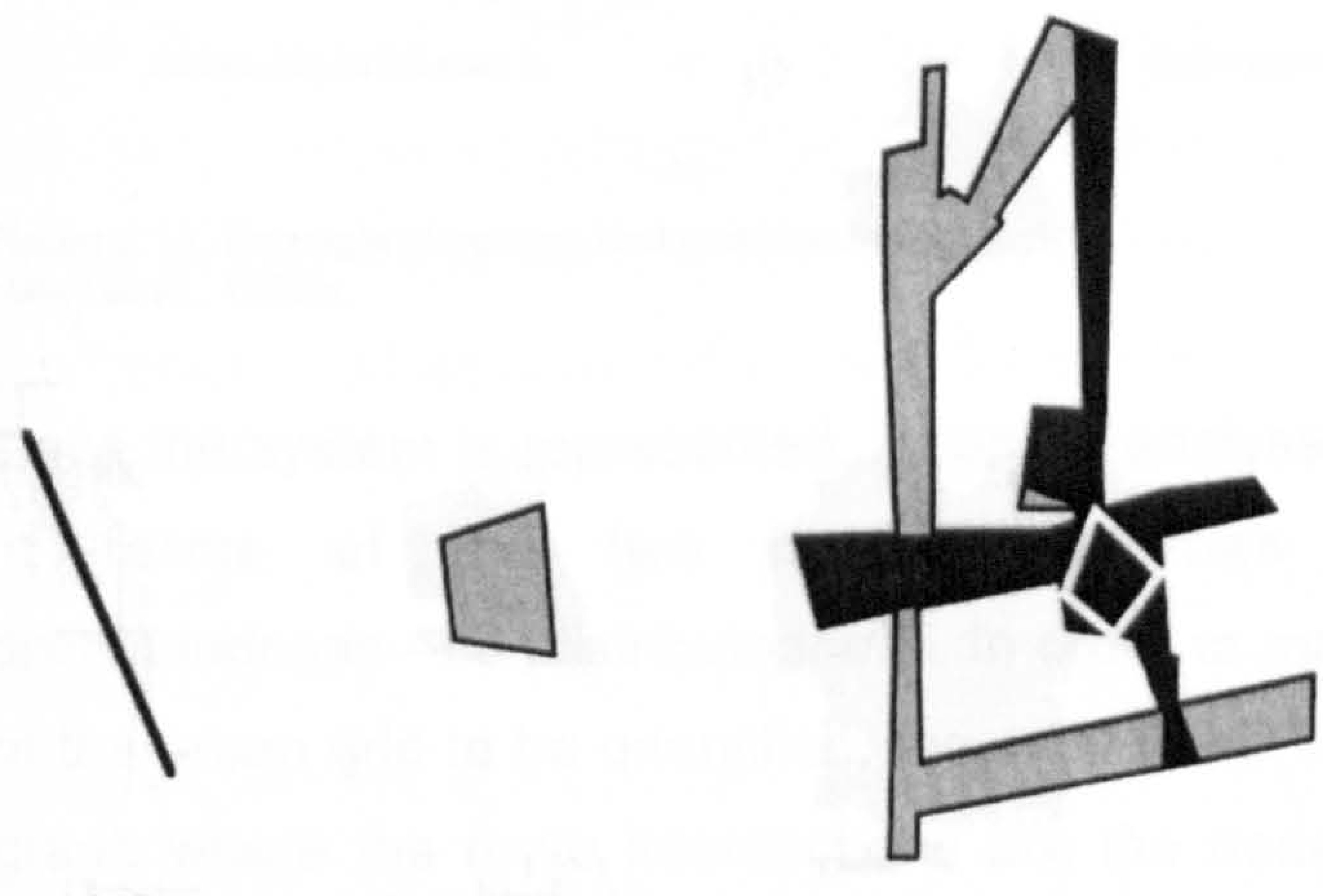

Figure 2.10. Examples of axial line, convex space and convex isovist
Hanson, 1998

Axial lines are associated with movement properties, giving information concerning where you might be going (Hillier et al., 1987b). Convex spaces describe where you are in the system. Hillier illustrates these properties very clearly.

> "At the most elementary level, people move in lines...Then if an individual stops to talk to a group of people, the group will collectively define a space in which all the people the first person can see can see each other, and this is a mathematical definition of convexity in space...The more complex shape of the third figure defines all points in space, and therefore the potential people, that can be seen by any of the people in the convex space who can also see each other. We call this type of irregular, but well defined, shape a convex isovist."
>
> (Hillier, 1996, p153).

The description and subsequent analysis of the spatial configuration of the urban layout is modelled via the convex and axial maps. The system of open spaces is represented firstly by the set of the fattest and fewest convex spaces. Secondly, the axial map is constructed by the fewest and the longest axial lines that go through all the convex spaces of the system, whereas every point in the system has both one and two-dimensional forms, as seen in Figure 2.11.

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27 Hillier and Hanson, 1984, p98.

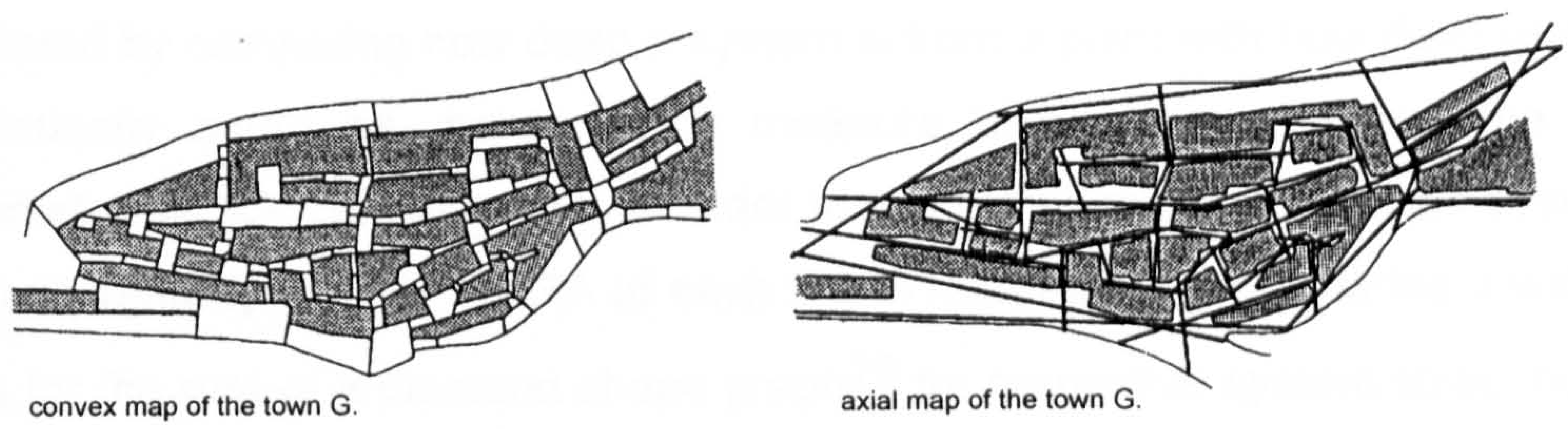

Figure 2.11. Example of convex and axial modelling
Hillier et al., 1987b.

Once the system is represented, it can be analysed as a system of syntactic relations in terms of the two basic properties of symmetry-asymmetry and distributedness—nondistributedness. In order to make it possible for the representation of the urban grid to be quantified, the axial break up map is then converted to an axial graph where the route intersections are the nodes and the route segments are the edges. The analysis of the axial graph is thus made through concepts of topological relations, and not metric distances; depth and shallowness is the most important topological relation. "The concept of depth is one of the most important relational ideas in space syntax. Depth exists wherever it is necessary to go through intervening spaces to get from one to another. Shallowness exists where relations are direct" (Hillier et. al., 1987b, p224). Therefore, depth measures how many steps from a given point in necessary to go through to a second given point, which in this context, means how many steps each line is away from another line. The resulting information is later added back to what is then denominated the integration axial map[28].

According to Hillier and Hanson (1984) the two basic relational and representational concepts are enough to permit the quantitative analysis of different spatial patterns in its whole and in its parts.

2.4.2. THE SYNTACTIC MEASURES

A key syntactic measure of configuration is integration. The integration value of each axial line reflects its mean depth from other lines in the system. The integration value

28 There are three models of representation, the axial and convex space maps and the convex isovists that are used in different forms. Research is a very dynamic process with new ideas being successfully introduced, such as the all lines maps (Hillier, 1996) or isovists integration analysis (Turner and Penn, 1999). Furthermore, this thesis will suggest a new analytic method for studying the patterns of static occupancy in public spaces named the overlapping point isovists maps. The overlapping point isovists analysis is discussed in detail in Chapter 6.

of each axial line is computed as follows. Firstly the mean depth of each line is calculated by comparing how deep a system is from a point with how deep or shallow it theoretically could be, producing a measure that is denominated the "relative asymmetry" or RA. Subsequently, in order to make it possible to compare systems that vary substantially in size, the RA of each line is relativised by comparing it with the RA value for the root of a diamond shape graph[29] for respective system sizes, now called the "real relative asymmetry" or RRA. Finally the reciprocal of the RRA (more often called simply integration) is calculated in order to find the most integrated space with the highest number, that is, the highest integration value[30].

The measure of integration[31] can be used from different levels. Radius-n (Rn) or global integration measures the relative depth of each axial line to all other lines of the system. The most integrated lines are the shallowest in the system and the most segregated lines are the deepest in the system. In other words, the degree of integration (how few steps is from everywhere else) measures numerically the degree of accessibility (the degree to which a line is present on the simplest and fewest changes of direction) of each axial line from all the others in the system. Radius-3 (R3) integration or local integration measures the accessibility up to three steps away[32]. Connectivity measures the degree of intersection (one step away) of each line to all the other lines in the system. Therefore, integration radius-n expresses global proprieties and radius-3 integration and connectivity local ones. In fact, it is possible to establish any radii measurement in search of the best description of an urban structure[33].

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29 The diamond shape graph is illustrated in Hillier et al., 1987b, p226. See also Hanson, 1989b, p86. The relativisation of RA (RRA) is an important measure for comparative cities studies such as the one carried out by Hillier and colleagues (1987a) that involved the syntactic analysis of 75 urban systems ranging from 13 to 892 axial lines. In addition, Chapter 3 of this thesis involves the analysis of 30 European towns, whose systems spanned from 12 to 294 axial lines, as detailed in Table 3.2 in Appendix 1.

30 Relative asymmetry (RA) is defined by: RA = 2(MD-1) / k-2; where MD represents the mean depth (of a line/space) and k the number of spaces in the system. The real relative asymmetry (RRA) is defined: RRA = RA / Dk; where Dk is the relative asymmetry of a diamond shape pattern of k spaces. For a detail explanation of the methods of calculation, refer to Hillier and Hanson, 1984, pp108-113. For the mathematical definitions of mean depth, relative asymmetry and real relative asymmetry, refer also to Appendix 2 in Hillier, 1986 and Hillier et al., 1978b.

31 The measure of integration is processed by computer software called "Axman" which has been developed at the Bartlett School of Graduate Studies, University College London, written by N. Dalton.

32 The computer software includes the first selected line as the first step.

33 Refer to Karimi, 1998 and Penn et al., 1998.

Integration[34] is currently the most important measure as far as the prediction of levels of pedestrian movement[35] is concerned, and will be discussed in more detail in the next section on the theory of natural movement.

Finally, there is the concept of intelligibility which is a descriptive measure of whole systems. Hillier defines it "as the degree to which what can be seen and experienced locally in the system allows the large scale system to be learn without conscious effort" (Hillier, 1996, p215). The mathematical expression was initially calculated by the degree of linear correlation between connectivity and a global integration value of axial lines (Hillier and Hanson, 1984) graphically illustrated in the "intelligibility scattergram" (Hillier, 1993). However, past research has suggested that radius-3 is a better local measure compared to connectivity for the prediction of pedestrian movement[36] and for the characterisation of the structure of local areas for the City of London[37], which this thesis adopts for measuring local properties of the urban grid. Therefore, the mathematical expression for "intelligibility" in this thesis is defined as the degree of correlation between local (radius-3) and global (radius-n) integration values of axial lines. Like integration, intelligibility is a very important measure because in practical terms it gives a quantitative description of how the whole can be read from its local parts. In an intelligible system, the information that we get locally as we move around gives us sufficient evidence of how the overall spatial system is constructed.

2.4.3. NATURAL MOVEMENT THEORY

During the 80's, reports produced by The Bartlett School of Graduate Studies (UCL) started to provide evidence that space syntax methodology was not only a very important tool for description, but also quantified the relationship between spatial configurations and the density of pedestrian movement in urban areas. After comprehensive study that involved collecting data in a range of urban, suburban and housing estate areas in Greater London, came the publication of the first large scale

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[34] As well as models of representation, there are a range of syntactic measures which were not applied in this research but that are also very useful in other contexts, such as control, choice, point depth or the radius-radius integration measure. See Hillier, 1986; Hillier et al., 1987a and Hillier, 1996.

[35] Also, the integration measure has been shown to be very efficient for predicting levels of vehicular movement. See Penn et al., 1991 and Penn et al., 1998.

[36] This point is discussed further next section.

[37] Refer to Hillier, 1996, Chapter 9.

reports with significant evidence of the correlation between integration values of axial lines and levels of pedestrian movement (Hillier, 1986 and Hillier et al., 1987a). Hillier and colleagues suggested that, despite the morphological variety of urban forms, there are consistent syntactic measures, mainly integration and intelligibility, that can be used effectively to determine the density of pedestrian movement in urban areas. In addition, Hillier and colleagues added two more important points: firstly that local facilities should not be seen as the primary component affecting patterns of pedestrian movement because they tend to be placed in suitable parts of the urban configuration; secondly, that a reduction in the predictability of patterns of pedestrian movement is strongly associated with the loss of intelligibility.

The theory of natural movement (Hillier et al., 1993a) grounded in the space syntax theoretical framework refers to the relationship between the spatial layout and patterns of use, that is, the pedestrian occupancy and movement in space, and how the pedestrian movement is affected by the spatial configuration. The theory of natural movement asserts that the pattern of pedestrian movement in an urban system is primarily generated by the configuration of the urban grid, as the pedestrians tend to follow the shortest and most direct routes. Hillier points out that, as extensive research showed, given that both forms and density are more or less homogenous and distributed in a grid like structure, and given that people are moving from everywhere to everywhere, there will be a strong correlation between the integration values of the axial lines of the urban grid and levels of pedestrian movement[38]. Hillier and colleagues accept that the multiplier effect of attractors, such as shops, can exceed the effects of the urban grid configuration in particular situations. However, without understanding the structure of the configuration of the urban grid, it is not possible to understand either the levels of urban pedestrian movement or the distribution of attractors. Attractors in fact take advantage of the potential natural pedestrian movement of the area rather than the other away around. Research has also indicated negative attractors, like the "fall off effect" where the level of pedestrian movement decreases as you move inside many council estates, are a function of the configuration of the urban grid (Hillier et al., 1993a), and that, as a result, inner communal recreational areas are often deserted.

[38] Prof. B. Hillier personal communication, 1995.

2.5. STUDIES OF THE PERFORMANCE OF PUBLIC SPACES USING SPACE SYNTAX METHODOLOGY

Probably the most significant study from the UK in recent years that looks at how urban public space is actually used, was carried out by Hillier and his colleagues as part of the report presented to the Mansion Square Public Inquiry in the early 1980's (Hillier, 1984). Hillier had been asked to comment on a proposal to redevelop the area around the Mansion House to include a large, new urban square in the very heart of the historic "square mile" of the City of London; specifically, he was asked to predict whether or not the new square would be successful in generating sufficient pedestrian movement and urban life to justify the creation of such a significant new public space in the centre of the City of London. In order to understand how public space was being used in the City at that time, Hillier conducted an empirical investigation of seven urban squares, three with wine bars and four without[39], that showed different degrees of informal use by static people. The aim was to try to understand why some squares seemed popular and well used, whilst others appeared empty and unused for most of the time. The challenge that the chosen public spaces presented from the outset was that it was immediately apparent that none of the design variables that had previously been thought of as important for successful, well-used and popular public urban spaces, such as an absence of traffic, a sense of enclosure or the presence of tall buildings, seemed to explain the levels and patterns of pedestrian occupancy and movement in the selected urban squares.

The study first produced a morphological analysis of the spatial structure of the urban grid of the City of London based on space syntax technique. It was followed by an investigation of moving and static pedestrian activity in the urban squares throughout the working day. One consistency was that the urban squares that were under-used seemed to be over-enclosed for their size. Also, from examining the plans of traditional cities, it was found that squares and larger open spaces act as gathering points for axial lines, as the open space is in a strategic position with respect to the surrounding system, which also ought to be in proportion to the size of the urban space. This led to the conjuncture that, in order to achieve a vibrant urban space, the length, number and integration values of the axial lines that are visible from within the urban square ought to be in proportion to the size of the square in terms of its metric area.

[39] These are: the Royal Exchange Buildings, Bow Church Yard and Paternoster Square with wine bars, and Commercial Union Plaza, North Guildhall Court, St Paul's Yard, and Old Change Court without.

In order to measure the strategic location of an urban space, Hillier suggested a distinction between different types of axial lines, viz., axial lines that go through the body of the square and axial lines that skirt past it. Figure 2.12 shows as an example the Royal Exchange highlighted by the grey circle, where the continuos thick black lines represent the axial lines that go through the body of the public space and where the dotted ones represent the axial lines that are adjacent the public space.

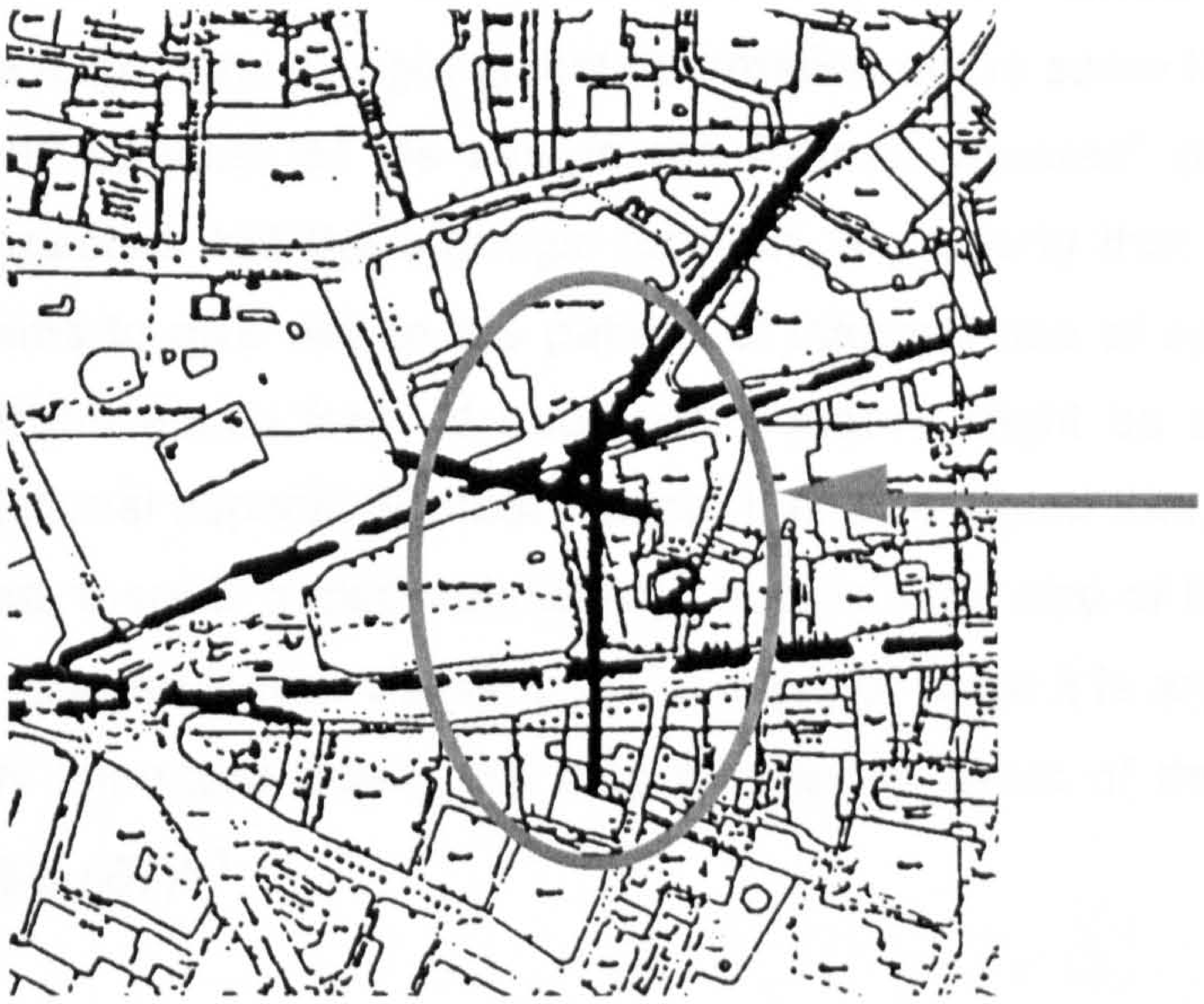

Figure 2.12. Interfacing and skirting axial lines
Hillier, 1984.

This distinction arises from the way in which the properties of visibility and permeability generate different degrees of connectivity between the urban space and its surroundings. It was therefore suggested that strategic location should be quantified by the sum of the global integration values of axial lines passing through the body of the urban square. This was referred to as the "strategic value" of the square. Based on this measure, it was possible to test if the rate of pedestrian occupancy of a square varied with its strategic value. It was found that there was indeed a correlation between the strategic value of the public spaces and the numbers of static people who were recorded there. In addition, it was established that there was a positive correlation between the integration value of the main axial line, defined as the line with the highest global integration value passing through the body of the urban square, and the total number of moving people observed passing through the square. Hillier therefore proposed that the formula for a successful urban square, which he suggests is a continuous use of the space rather than use at the rush hours[40], depended on there being a proportionate balance between static and moving people.

The question of the strategic location has been further investigated in another series of research projects which all seem to lead to the same conclusion, i.e., "the information you get locally from the visual field you experience as you move around, gives plenty of clues about how the overall spatial system is structured. In intelligible urban space, one might say, you get global information at the same time as you get local information about spaces, as we saw in the Roman squares" (Hillier, 1993, p16). Again, it is suggested that the strategic location, a property that belongs to traditional squares, seems to give rise to the pattern of informal use of space. This raises the possibility that the actual form of traditional squares might be a determinant of at least some functional aspects of urban space. It is also stated that, where urban squares are well-used, there is a clear relationship between the size of the urban square and the size of the convex isovist visible from the square, since it is arguable that local spaces are not only important locally but also globally in terms of the structure of the town (Hillier, 1988, p67)[41].

According to Hillier, "very little of the open space can be described as enclosed in the localised sense...[when discussing the French town of Apt]...enclosed spaces have the important additional property of being also strategic spaces from which a good deal of the larger scale space structure of the town can be seen" (Hillier, 1988, p65). In other words, not any kind of enclosure will do. The relation between the building surfaces that enclose the square and the openings which connect it to the wider street system need to be provided in a way which reflects the strategic value of the square, its metric size and the kind of informal uses which it is intended to support.

These findings on urban use are consistent with another, more recent, study carried out by Hillier and colleagues on the open public spaces of Broadgate, a large office development in the City of London (Hillier et al., 1990a). The study showed that, as discussed in previous research, by comparing Broadgate to six other public spaces in the area, the number of people choosing to stop and make use of the space is a

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[40] The rush hours are 8 – 10 am and 4 – 6 pm (Hillier, 1984, p6).

[41] See also Hillier, 1991b, p20.

function of the number and degree of integration of the axial lines passing through the body of the square, that is, the strategic value.

Regarding preferred locations for static occupancy, it was suggested in the Broadgate study that (with reference to the Mansion House Square Report) good locations for unprogrammed use, defined as those uses that do not depend on the provision of specific attractions or facilities in the square, were found to be those which were convexly related to the intersections of integrating lines, not in the intersection, but close to it (Hillier, op.cit., p6). It was also concluded that static activities have the opposite property to movement activities. For people engaged in static activities, once they have arrived at the square by using the linear properties of space, the linear structure becomes less important and the visual properties become more significant. This can be measured by looking at the properties of the visually strategic convex isovist, where stationary people prefer areas with extensive isovists (Hillier et al., 1990a and Hillier, 1993).

2.6. STUDIES ON PREFERRED AREAS FOR UNPROGRAMMED STATIC ACTIVITIES AND THE GRADUAL OCCUPATION OF PUBLIC SPACES

In line with the objectives of this research, the last section of this chapter introduces relevant ideas on the gradual occupation of public spaces and the preferred locations for unprogrammed static activities.

From all the activities observed in public spaces, on the analysis of relevant publications, it is generally accepted that "people browsing" is the main activity that users engage in. This will have consequences in people's preferred location when using public spaces. It is recognised that the adequate provision of seating places is an important issue for the public space if it is not be used only as a transitional area but as a place where people can gather and utilise it effectively. Gehl (1987) suggests that adequate seating is important for stays of any duration. If these opportunities are few or bad, people just walk on by. This means not only that stays in public are brief, but also that many attractive and worthwhile outdoors activities are prevented. Therefore, not only should seating places be adequate for human needs but also, very importantly, the adequate provision and spatial distribution of seating places can contribute to the success of public spaces.

According to Alexander et al. (1977), because people enjoy looking at the pedestrian flow, the life of public spaces forms naturally around their borders and edges where people gravitate. Once they are full, the gradual occupation will naturally turn inwards. "If the edge fails, then the space never becomes alive (Alexander et al., op.cit., p600), and therefore the space will become a place to walk through and not a place to stop".

Gehl (1987) calls such a property the "edge effect" (Gehl, op.cit., p159) and it is widely accepted in research conducted by a number of different investigators. In fact, Gehl adopts this terminology from De Jonge (1967). Jonge, after observations on static occupation in a series of recreation areas (parks and roadside resting places) claims that "other things being equal, the parts of the areas near the main entrances are parking areas and used more intensively than the distance parts...This phenomenon can been called the "edge effect"...There is also an "island effect," which is to be regarded as the edge effect on all sides" (De Jonge, op.cit., p10). According to Gehl (1987), the edge is the preferred location for standing or sitting when people first occupy the borders and edges of the public spaces, and only once they are fully occupied, do people tend to move inwards. The edge effect exists because people prefer to sit in areas facing the pedestrian flow, and therefore the location on the boundary of the public spaces will provide the best views, with extensive and richer visual fields. Gehl suggests that benches that provide a good view of the surrounding activities are used more often than benches with less or no view of others since human activities are the main attraction for users of public spaces. Although Gehl makes a distinction, claiming that the location for sitting is chosen more carefully than standing, he points out that the edge effect is observed in both cases.

Carr (1995), from his study of Boston City Hall Plaza confirms that people prefer initially to sit in areas facing the pedestrian flow and therefore avoid central or recessed areas where the view is generally devoid of the activity provided by the pedestrian traffic. Marcus and Francis (1990) also highlight the importance of the edge as the first place to be populated by users. "People universally tend to sit on the edges of spaces, rather than in the middle of them" (Marcus and Francis, op.cit., 29). Specific to the gradual occupation of the edges, people prefer locations within view of busy traffic on moving people. Linday (1978), Joardar and Neill (1978) and Korosec-Serfaty (1982) all suggest that edges are better sitting locations due to their viewing option than the centre of public spaces. The implications in the final detail of open space layout suggest that, in order to improve the success of public spaces, activity pockets (shops, benches, etc) should be placed at the edges alongside access routes.

Alexander et al. (1977), Gehl (1987) and Marcus and Francis (1990) add that despite the gradual occupation of public spaces following an outside to inside movement, people tend to avoid very wide open spaces, looking for areas which are neither too exposed nor too enclosed, favouring a combination of unobstructed views of street activity and a degree of privacy. The edge effect plays a relevant role but orientation and view are also important. Gehl claims that well protected places to sit, with an unobstructed view of the surrounding activities are always more popular. Whyte (1980) points out that people select a location that fulfils several requirements. The choice not only reflects the desire to locate oneself as an audience to a particular activity, but also, and at the same time, the desire to define oneself as a particular kind of actor on the public stage. "Men show a tendency to take the front row seats, and if there is a kind of gate, men will be the guardians of it. Women tend to favour places slightly secluded" (Whyte, op.cit., p18). He adds that the heaviest concentration of static people both sitting and standing is near the areas with the highest flow of moving people, because people watching is the activity that most attracts people who go to public spaces. Consequently, people seldom prefer the location in the middle of a large space. The Project for Public Spaces (1982) and Marcus and Francis (1990) agree with Whyte. Marcus comments that because people universally tend to sit on the edges of spaces, rather than in the middle of them, the edges or boundaries of a plaza should, whenever possible, be planned for seating and viewing. Also, it is suggested, according to the findings by Joardar and Neill (1978) there is a tendency for people to linger around well-defined focal elements such as fountains and flowerbeds.

As far as users' specific activities are concerned such as reading or people watching, a popular interpretation is that secluded areas far from the pedestrian flow and the direct observation of others create private spaces and are therefore favoured by people desiring privacy (Marcus and Francis, 1990 and Nasar and Yurdakul, 1990). Carr (1995) mentions: "Individuals and small groups seeking privacy are frequently found in the section of a public setting that it is the farthest from the pedestrian flow and the direct observation of others" (Carr, op.cit., p60). Lennard and Lennard (1995) claim that people choose different locations, that is, some sit where they have maximum visibility, others prefer a more sheltered location. Likewise, some might prefer sunny areas instead of shaded ones, close or far from action, but essentially according to each user's personal agendas. Burden (1977) suggests that users select different areas of public spaces according to the activities that they are engaged in. Couples favour secluded areas, whereas "socializers and observers tend to favour the front edge [of Greenacre Park] where they can view the street scene and be sure not to miss the entrance of an acquaintance" (Burden, op.cit., p31). Whyte (1980, 1988) agrees with this point of view. He suggests that this may be related to "primeval instinct". We have a full view of all comers but at the same time the rear is covered, although Whyte recognises that protection does not explain the popularity of curbs where users "face inwards, toward the sidewalk, with their backs exposed to the dangers of the street" (Whyte, 1980, p22). According to Whyte, people talk mainly at corners, although Nasar (1990) in a study of patterns of behaviour in public spaces, claims that people talk all over the place, and concludes that benches far from main activity centres are badly used. A combination of high pedestrian volume, eating, and destination points will suggest where to place the seating areas.

2.7. DISCUSSION AND CONCLUSIONS

From Sitte to Moughtin, the theoretical study of urban squares of traditional cities have all suggested, with different degrees of importance, that enclosure and the irregularity of the enclosing elements are important morphological characteristics for creating successful public spaces. Occasionally, mentions were made of how urban squares were embedded in the urban fabric, but these ideas were little developed compared to those dealing with the immediate spatial properties of the urban squares. Only enclosed spaces could provide the user with a sense of well being, comfort, feeling of protection and pleasure. Spatial enclosure is generally seen as a positive feature since it adds significance and meaning. It has become a well-rooted concept amongst authors studying the performance of public spaces. From ideas about spatial enclosure and the irregularity of forms, more recent studies on the subject have shifted to ideas embracing attraction theories. Once we know what people expect from public spaces in order to fulfil their social experiences, it is just a matter of providing them with the amenities to satisfy their expectations, and therefore public spaces are bound to be successful. The work of Francis, Lennard and Lennard, and Carr concentrate on producing design guidelines consisting of the height of surrounding buildings, the floor texture and the dimension of seating places. In all cases, the public spaces are seen as spatial features with no relation to their surroundings.

It is clear that these previous concepts are rich in the description of spatial elements, yet reveal a lack of formal representation of space. They are restricted to the primary properties of objects measurable on their own, such as the relationship between the width of a public space and the heights of a building, or secondary properties[42] such as the preference for green spaces which depend on a user's personal taste. Any kind of quantification with direct implications for patterns of spatial use by people is much more subjective.

Whyte's pioneering work looks at all these properties and points out that, with the exception of some elements that can contribute to the performance of a public space, none of the spatial characteristics are really determinants for the levels of static people inside public spaces. It is the adjacent streets and their respective levels of pedestrian movement which play a major role, with good visual and permeability connections between "street and square" as the key issue. Although Whyte elucidates important aspects between the relationship between levels of pedestrian movement and the performance of public spaces, he is still not able to provide (although maybe it was not his aim) a method of quantifying or predicting the likely number of users. Likewise, the edge effect (Gehl, 1987) and the implications of the gradual occupation and preferred locations of static people is an important property that deserves further investigation.

Although stressing important properties that may contribute to the overall quality of public spaces, these studies provide little evidence of how to represent the public space and quantify those properties in relation to social variables. A very important aspect of space syntax methodology is the concept of relative depth subsequently expressed by the integration value[43]. Therefore, using space syntax, it is possible to look at public spaces not as independent spatial entities, or the relationship between two elements, street and square, but in a configurational analytic process. Besides, a second aspect is the evidence through the theory of natural movement of the possibility of correlating spatial variables to spatial behaviour. In other words, syntactic measures such as integration and intelligibility can be tested against the patterns of use of static people in public spaces. Hillier and colleagues have moved from the traditional ideas on spatial relationships to spatial configuration and with the

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[42] The primary properties of objects are independent of observers. They are seen as extensions of the objects and therefore measurable in terms of length or width. The secondary properties such as "green" or "nice" are the ones depend on the interaction between observer and object (Hillier, 1993, p10).

[43] See discussion in Sections 2.4.1 and 2.4.2.

formulation of space syntax methodology, are able to suggest why so many public spaces fail despite careful design. The most important conjecture raised by previous studies on the performance of public spaces using space syntax methodology is the concept of strategic value (Hillier, 1984). The importance of further investigating such a property in more comprehensive research will enable us to effectively quantify and predict the likely numbers of users of public spaces in a scientific manner.

Space syntax[44] is therefore used in this research because it showed to be a methodology capable of escaping from attraction and deterministic approaches and presenting a global interactive view of the relationship between patterns of spatial use and public spaces design. Despite of all obvious advantages in employing space syntax in this research, space syntax does not exclude other information or theoretical approaches being brought to the analysis as done in this research. It has to be used creatively with careful handling of the data and common sense. However its own strengths comes from the continuous on going research that feeds back new knowledge into its theoretical and methodological framework. Space syntax is therefore the main methodology used for this research for the spatial analysis where methods of collecting data in order to correlate the spatial form to human behaviour are discussed in the following chapters.

However, before embarking in the experimental aspects of the research, this thesis explores the previously mentioned conjecture regarding to the spatial properties that might be relevant to the performance of public spaces which may also be found in examples of traditional urban squares. In particular, on the extent to which enclosure actually is an objective property of traditional urban squares. It may be the case that previous authors have exaggerated the importance of enclosure and have failed to note the existence of sight lines, which link the square to the larger scale urban fabric. If this is so, a careful study of how traditional urban squares are embedded axially in their urban context should reveal useful insights into precisely how the relationship between local enclosure and global embeddedness is constructed spatially.

[44] Space syntax theory has come a long way since the first publications in the early 70's. A vast number of MSc and PhD theses and academic research at University College London and other institutions in the UK and abroad, consultancy studies world-wide and two international symposiums, have long established a solid reputation for the use of space syntax as a tool for the description, interpretation and quantification of the built environment. Gospodini (1988) in her PhD research successfully used space syntax methodology in a previous study on the relations between the type and function of urban squares.

3

THE MORPHOLOGY OF URBAN SQUARES OF EUROPEAN TOWNS

This chapter is a morphological study of a selection of 30 traditional urban squares chosen from 30 European towns. The aim is to develop a methodology capable of describing their built form and the way they are embedded in the urban fabric, in order to identify common morphological characteristic's. These findings can then be used as a basis for comparison with a subsequent, more detailed study of observed patterns of spatial use in twelve contemporary examples of public spaces from just one city, the City of London. It is conjectured that any consistent regularities that can be established for the generality of historical urban squares might help to explain why some recent examples appear to "work" well and others not. This chapter is structured in three main sections. Firstly, a description of the sample is presented, followed by a discussion of the methodology employed for the analysis. The last section involves the analysis itself.

3.1. INTRODUCTION

One of the two propositions which this study starts from, suggests that if there is a relationship between the morphological characteristics of modern public spaces and their patterns of use, this can be translated into a number of common morphological properties that are also characteristic of traditional urban squares. It is believed that, from historical texts and as many current examples show, urban squares within the historic cores of traditional towns had and still have an important part to play in the social life of their inhabitants. By understanding what these properties are, one may also begin to understand why many modern public spaces seem to have failed. Thus, the main purpose of this analysis is to investigate the existence of common morphological characteristics within a sample of traditional urban squares.

In making this comparison, this thesis is set within a long tradition in urban analysis which has its roots in the closing decades of the nineteenth century. However, in comparison with other authors who have explored a sample of traditional urban squares as a method of searching for morphological characteristics relevant to their performance, this investigation establishes a rather different approach. Instead, it is believed that public spaces should not be studied as entities independent of their embedding in the urban fabric. In addition, this investigation approaches the quantification of properties of space.

The elements selected for investigation are those which are claimed by the authors studied in the literature review to be important for the population to engage with in a static occupation of the public space, they should not simply use it as a transitional area between destinations. The investigation concentrates on those features that may contribute to an authentic urban way of life. However, although some important points which touch on the social performance of traditional and modern squares have undoubtedly been highlighted by previous authors, this study conjectures that there could be other spatial elements that may play an important role in the performance of public spaces that have not been identified in earlier studies, but which can be pinned down by the latest generation of computer-based analytic techniques.

Therefore, in considering the aspects highlighted by the theoretical background as relevant for successful public spaces, this chapter will investigate how far the common morphological characteristics identified by previous authors can really be found in traditional urban squares. Specifically, it aims to clarify the relationship between "enclosure" and "embeddedness" which has emerged as a controversial issue which may affect the working life of public spaces, and which therefore seems to be as important to contemporary urban design theories as it is to our historical interpretation of the role played by urban squares in the distant past. At the same time, the investigation will be broader ranging in its scope, and will search for and test many of the important features that previous authors have suggested may affect the static use and movement potential of urban squares, focusing on the relationship between the urban square and its visual and permeability links with the urban fabric.

This study is based on three main types of investigation, according to the morphological properties to be explored, and it is these which define the main structure of the chapter.

Firstly the analysis will address two-dimensional description of space, referred to in this study as the "convex and isovist analysis". It investigates the relationship between the urban square and its visual connections in relation to the urban environment. In total, six measures will be analysed: the metric area of the main convex element which defines the urban square[1], the metric area of convex isovists, the sum of isovist lengths, the mean sum of isovist lengths, visibility ratio and enclosure ratio. All these properties will be discussed in detail in Section 3.3.3.1.

Secondly, the analysis focuses on the description of space at local level, referred to as the "intersection axial line analysis". It investigates the relationship of the urban square and just those axial lines that interface with it. Nine measures are used. In addition to the metric area of the main convex element, the number of axial lines, the sum of their length, the mean of the sum of their length, their local and global integration values, strategic value, local strategic value and intersection points, are all analysed. In addition, the axial lines that interface within the urban square are studied according to a new criterion introduced in this research that focuses on how those axial lines deploy themselves in spaces, discussed in detail in Section 3.3.3.2.

Thirdly, the analysis will address the description of space at global level, referred as the "embedding analysis". It investigates the embedding of urban squares in the global structure of the urban fabric. To this end, it compares the local and global integration values of axial lines of the urban system to the ones that interface with the urban square, discussed in Section 3.3.3.3.

All the measures will be discussed in detail in the relevant sections. Table 3.1 (Urban squares in European towns: description of measurements) gives a description of all the measures used in the morphological analysis. Table 3.2 (Urban squares in European towns general data table) compiles all the data for each of the urban squares. Finally,

[1] This will be discussed in detail in Section 3.3.1.

Tables 3.3 and 3.4 (Urban squares in European towns correlation matrix core sample and whole sample) gives an initial picture of how the measurements used in the morphological analysis correlate against each other. All these tables are to be found in Appendix 1.

3.2. THE COMPOSITION OF THE SAMPLE

The vehicle for the study comprises a selection of 30 traditional urban squares in towns[2] from Eastern and Western Europe[3]. Although the majority of the chosen examples are from towns dating from the XI to the XV Centuries, the origin of the respective towns can be as early as the III Century AD[4]. The plans[5] (Plate 3.1 in Appendix 1) were selected from maps dated from the late XIII to the middle XIX Centuries, selected purely on availability, which included an appropriate scale reference, clarity of drawing and as broad a variety of geographical areas and terrains as was possible.

The span of the dates of the selected plans ended up by being rather wider than was originally envisaged at the beginning of this study, due to the impossibility of finding reliable maps from the Medieval period. Most of the few available maps from this period tend to be either pictorial maps or maps in which the resolution of the information is too unreliable for the present study. As it was, some of the selected maps were difficult to interpret. Therefore, whenever necessary, the maps have been checked against their contemporary counterpart, to ensure that the interpretation of the grid layout and the scale of the overall plans used in this study are as accurate as possible.

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[2] From the literature, not always there was evidence whether the particular "place" was a village, town or city. "Town" was adopted as the generic term employed in this study.

[3] The towns that comprise the sample are: Völkermarkt and Wolfsberg (Austria), Bruges (Belgium), Klatovy, Kutna Hora and Litomerice (Czech Republic), Montauban and Verdun (France), Esslingen, Heilbronn, Kempten and Magdeburg (Germany), Gyor and Pest (Hungary), Borgomanero, Modena, San Gimignano and Scarperia (Italy), Nijmegen and Groningen (Netherlands), Brive, Kalisz and Wielun (Poland), Portalegre and Evora (Portugal), Castellon de la Plana, Moguer and Palencia (Spain) and Caernarvon and Salisbury (UK).

[4] This is the case for Verdun (France).

[5] The plans were taken from the following books: Beresford, 1967; Friedman, 1988; Gerevich, 1990; Gutkind, 1964-72; Linares, 1991; Lobel, 1975; and Mil. Geo Studie, 1941.

For each town just one urban square was selected. The urban squares were chosen either for being the oldest in the town or the one where a major building or special reference as a trading place was involved. To help in the selection process, the cartographic record was supplemented by information extracted from the literature. When this type of information was not available, the selected urban squares were taken to the largest open space area in respect of the urban grid. It is important to note that the selection was as random as possible as far as the spatial and syntactic elements are concerned. It was an important aspect of the research design that no attempt should be made at this stage to select for, and hence to pre-determine, the morphological characteristics of urban squares.

It should be noted that, as discussed previously, this thesis does not propose to focus on the historical determinants that may have been reflected in the development of each individual case that makes up the sample of 30 public squares, such as when, why or by whom they were built and how they came to be located on their particular sites. Therefore, no attempt is made to discuss their formative years, and neither was their historical background considered when selecting the sample.

3.3. METHODOLOGY

Before we set out the morphological analysis, some basic issues are addressed, specifically how to represent the urban square, how to describe the selected cases of the sample and how to define and quantify the family of measures and the methodology for the data analysis.

3.3.1. DEFINING AND REPRESENTING THE URBAN SQUARE

At this stage therefore, it is necessary to define the basic element used in the morphological analysis of urban squares. The first and maybe the most difficult question is how to define and represent the space delimiting the urban square, as all the other measures to be used are derived or directly associated with it. In this study, it proved very difficult to establish the spatial boundaries of the urban square from the available plans. Not only was this because the plans did not show a high level of detail, which might be expected from plans from a variety of different historical periods, but also because, in all probability, there was not a formal spatial division between public squares and (vehicular) streets as we know them today. Although there were probably established informal pedestrian routes, the transition between urban squares and streets or "spaces and paths"[6] was likely to be blurred. Therefore, in most of the selected examples, more than one solution for the urban square could be applied to the same open public space, even with information from the literature referring to a certain area as a "market square". At the same time, this apparent characteristic of there being no clear boundary between urban squares and streets may provide a clue as to what might emerge as an important ingredient or vital spatial element contributing to vivid public spaces. For example, Whyte (1980) concludes that a fundamental morphological element for successful small urban spaces is the degree of easy access from the urban square to the surrounding streets. Whyte points out that "The area where the street and plaza or open space meet is a key to success or failure. Ideally, the transition should be such that it's hard to tell where one ends and the other begins" (Whyte, op.cit., p57).

Figure 3.1 shows three examples of how an urban square might be represented. In Figure 3.1a, the urban square is defined by the available open space in the midst of the surrounding buildings. In Figure 3.1b, what appears to be an important north-south route is eliminated from the first adopted representation. In Figure 3.1c, the two east-west routes adjacent to the open space are also eliminated.

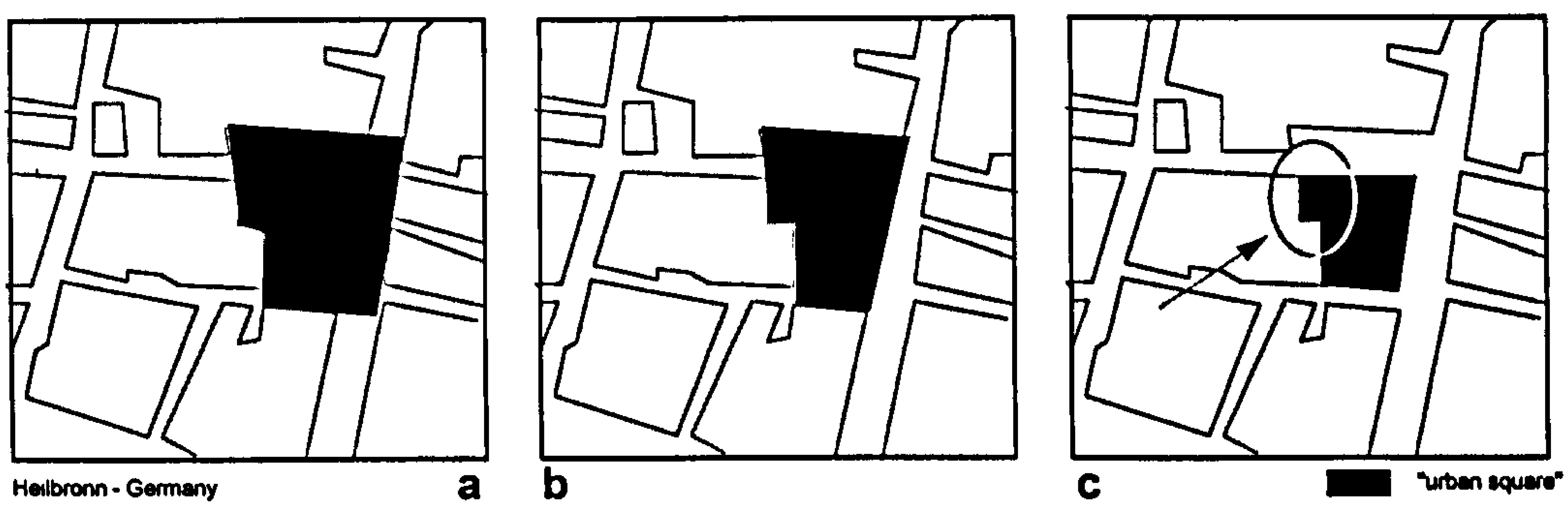

Figure 3.1. Different ways of spatially defining an urban square

In additional to the lack of information on the spatial boundaries of urban squares in relation to surrounding streets, two important issues contribute to the problem of definition. Firstly, as highlighted by the grey circle in Figure 3.1c, there are often recessed areas which may or may not function as an element in the urban square. Secondly, there are occasions where a building, generally a church (refer to Figure 3.3), is placed inside the urban square.

[6] This term was originally used by Hanson, 1989, p69.

All of the above serves to stress that it is fundamental at this stage to introduce a clear methodology for describing traditional urban squares prior to investigating the existence of morphological characteristics so that it is possible to be consistent across all the cases in the sample and to overcome features of the historical built up environment which can no longer be observed.

If we associate streets with pedestrian movement, urban squares in contrast, are basically open spaces that we associate with static people, although of course we cannot altogether ignore pedestrian movement through them. However, in the present analysis, we are looking for a way of representing the urban square where the primary interest is in unique continuous space in so far as all the inhabitants[7] of this space can establish a spatial relationship to one another. That is, they wish to construct a visual interface with each other simultaneously, with no exclusion. In order to be consistent and to introduce a representation that could be applied to all cases regardless of the level of complexity, the convex space concept as introduced by Hillier and Hanson (1984)[8] is adopted. In other words, the space defining the urban square will always be a space in which everyone is visible to everybody else, although in the majority of the selected examples (18 out of 30) the space that is associated with the urban square itself is not a convex space as such due to the existence of recessed areas as discussed previously. Put another way, this means that for 18 of the 30 cases, the shape of the space defined by the building façades and points of entry to the urban square contains more than one convex space[9].

The spatial boundary of the urban square is therefore defined by the biggest convex space with regard to the geometric area that could be inserted in the selected open space, limited by the façades of the building blocks, and it will be referred to as the "main convex element". Note that when discussing a two-dimensional representation of a spatial system, Hillier and Hanson adopt a different criterion for selecting convex spaces, namely, "the convex spaces that have the best area-perimeter ratio, that is the

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[7] In this case, the term "inhabitants" does not have the same meaning as previously introduced by Hillier and Hanson (1984). Here, the term "inhabitants" refers to all the people occupying the same convex space at the same time, being either familiar or strange to the environment.

[8] Refer to Section 2.4.1 in Chapter 2.

[9] Table 3.2 also shows which of the convex "squares" are coterminous with the urban envelope of the surrounding buildings, and which have ancillary convex spaces around the perimeter, a feature noted earlier in 18 of the 30 cases. For the convexity properties, "singularity" refers to the convex public squares that are coterminous with the urban envelope of the surrounding buildings. "Multiplicity" refers to the ones that present ancillary convex spaces around the perimeter.

fattest" (Hillier and Hanson, 1984, p17). Figure 3.2a shows the urban fabric of the town of Kutna Hora as in the original plan, and Figure 3.2b shows how the convex space representing the urban square is defined.

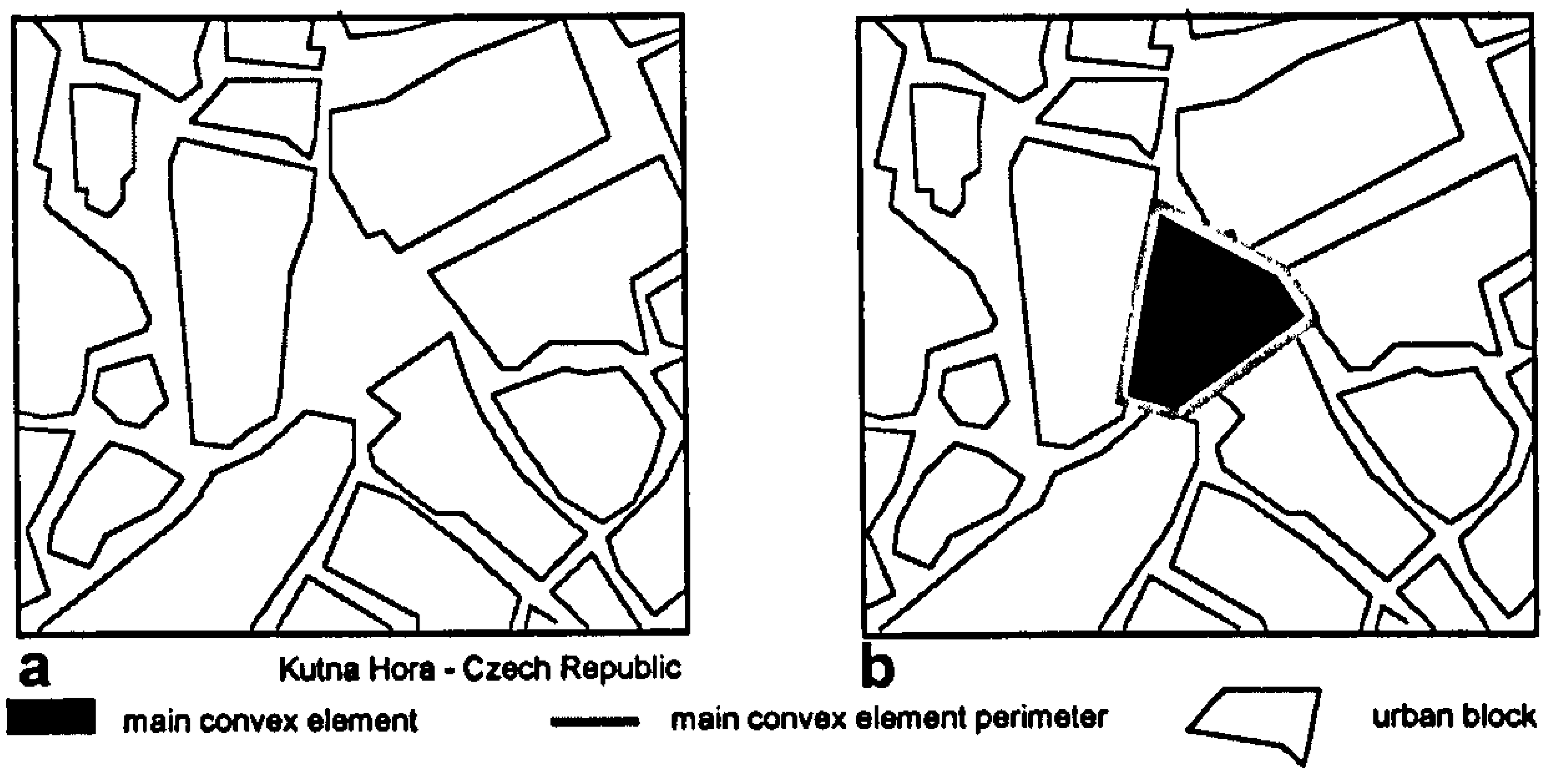


Figure 3.2. Example of the main convex element defining and representing the urban square

In the case of two candidate spaces with the same area, the convex space that most approximates a square geometric shape will be the one selected. Consequently, the spatial area of the respective convex space defines the most compact spatial area of the urban square. Plate 3.2 (Appendix 1) illustrates the convex break-up of the urban area with the main convex element highlighted in black.

Once the primary spatial element is defined, all the subsequent spatial and syntactic measures are derived from the main convex element, which will be discussed in detail in Section 3.3.3.

3.3.2. DESCRIBING THE SAMPLE

As previously discussed, typological classification is a common practice amongst many of the authors involved with the design of urban public spaces who make extended use of typological classifications as a tool for studying the morphology of urban spaces[10]. It was therefore decided to examine here how the selected sample was constructed according to two initial criteria: their named social function (when the information was available), and degree of regularity of the urban grid[11].

[10] As discussed in Section 2.1, Chapter 2.

[11] Geographical location was another criterion conjectured as it is also present in the literature, as in Sitte's comparison of Italian and Northern Europe urban squares (Sitte, 1889). Such a proposal was later dismissed since political boundaries, as we known them today, have never been constant through history.

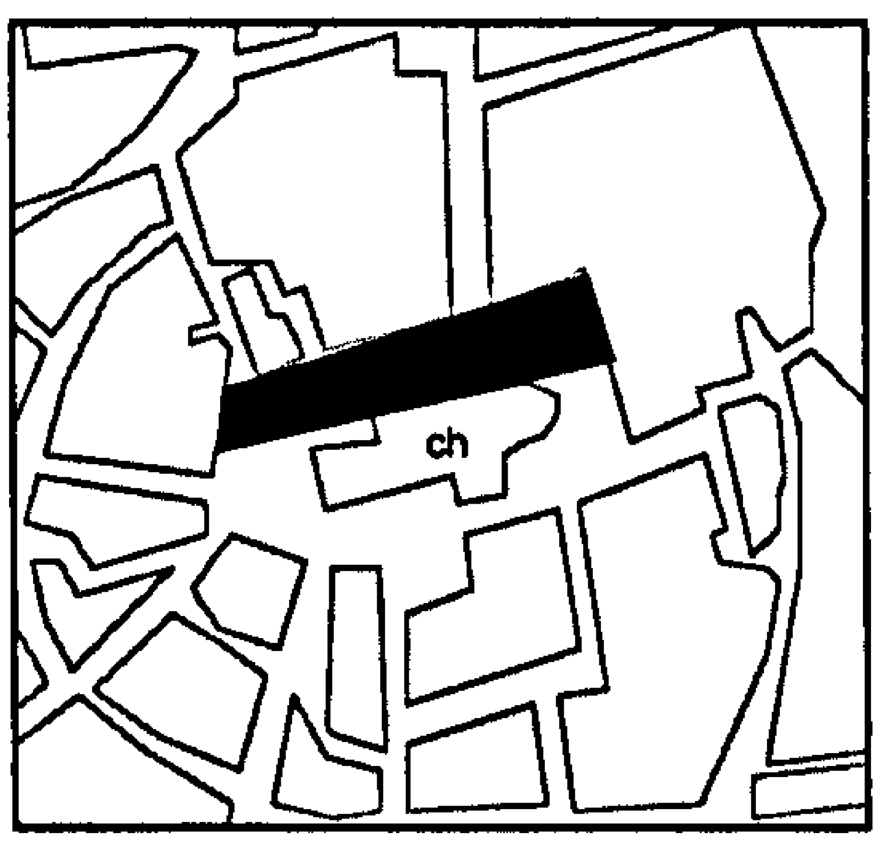
The purpose of this preliminary classification is not intended to be a definitive one, where the study of morphology of urban squares will be structured around it. On the contrary, the distinction is solely a procedure to sort out the sample intuitively, with the purpose of helping to establish clues as to the study of morphological characteristics and to inquire how far they prevail along the different items in the sample.

3.3.2.1. Main social function

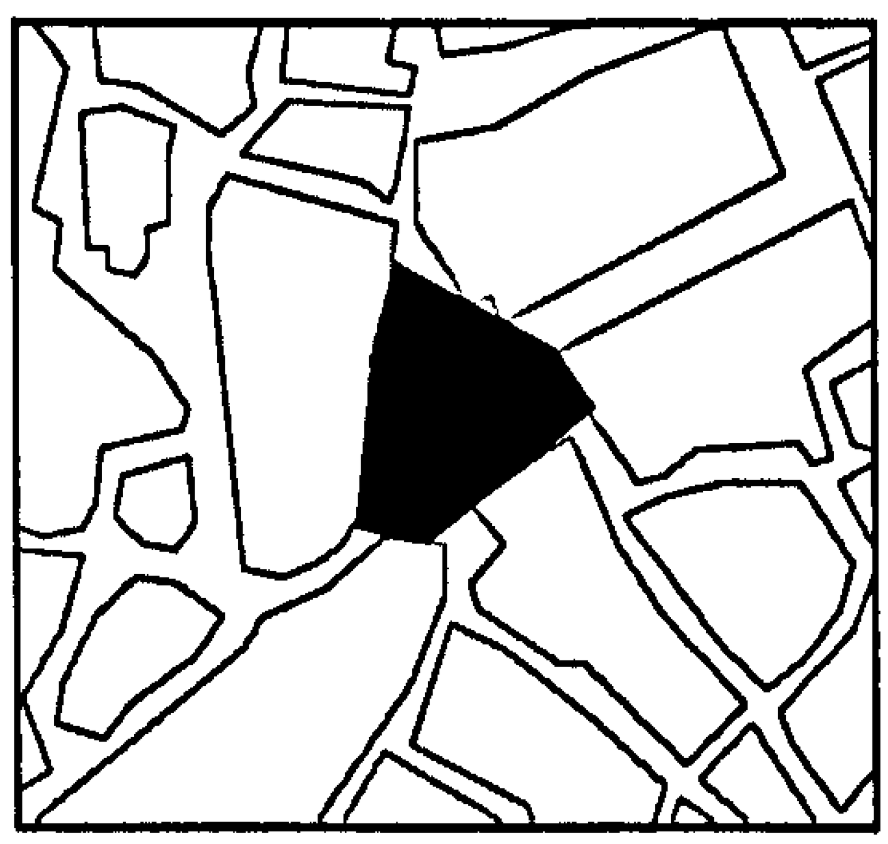
When considering the social function, attempts were made to extract from the literature the use of each urban square in the sample. Although in some cases the space was clearly identified as a market square, for instance, on many other occasions the information was not so evident. In fact, it emerged that the social function of an urban square very often changed during the course of its history. Kostof (1992) mentions that urban squares may not only have multiple uses but that also very often the uses change with time. Zucker (1959) points out that, "many market squares may develop later on into monumental civic centres" (Zucker, op.cit., p8), as happened to the Piazza de San Marco (Italy) that "began its life as a small medieval square "filled with market stalls" and gradually was (sic) changed into a grand Renaissance civic plaza" (Carr et al., 1995, p55).

Although most urban squares in the sample tended to have a specific use, that is, either a market or a religious square, for instance, it was also common for urban squares to hold more than one social function at a time. The functions of a square may be political, religious, social or economic in their nature, and examples similar to the case of Freiburg (Germany) which (was) a typical empirical market square, faced by a church and a city hall, were not uncommon. "When social interaction is counted all four behavioural factors are found here" (French, 1978, p40). Still referring to the Piazza de San Marco, Girourard (1985) points out: "The piazza, like many squares everywhere, was also used for a wide variety of public events....from bullfights and tournaments to processions....or religious feasts....At all times of a crisis the people gathered in the piazza in enormous numbers....victories were celebrated with bonfires in the piazza" (Girourard, op.cit., p108).

The 30 urban squares were therefore classified according to the dominant social function as church, main, market or civic. "Church square" (Fig. 3.3) is the term used when a church is situated as an isolated building, located in the centre of a major open space. Since the focus of this paper is on continuous open spaces, the main convex element of church squares does not include the church itself and is selected by taking the biggest convex space, as far as the area is concerned, from all possible permutations around the church building. The urban squares referred to as "main" (Fig. 3.4), are those where there is no clear evidence in the literature of the social status of the square. In this case, the squares were selected by indications of being the oldest square in the town or of a significant size when analysing the urban grid. "Market squares" (Fig. 3.5) are the ones where all the indications in the literature point to the fact that the square was used for trading. Finally, "civic" is the name given to those urban squares where a church is located at the perimeter (Fig. 3.6). In this case, there is usually some evidence that another civic building such as the City Hall also faces into the same urban square.



Brive - France

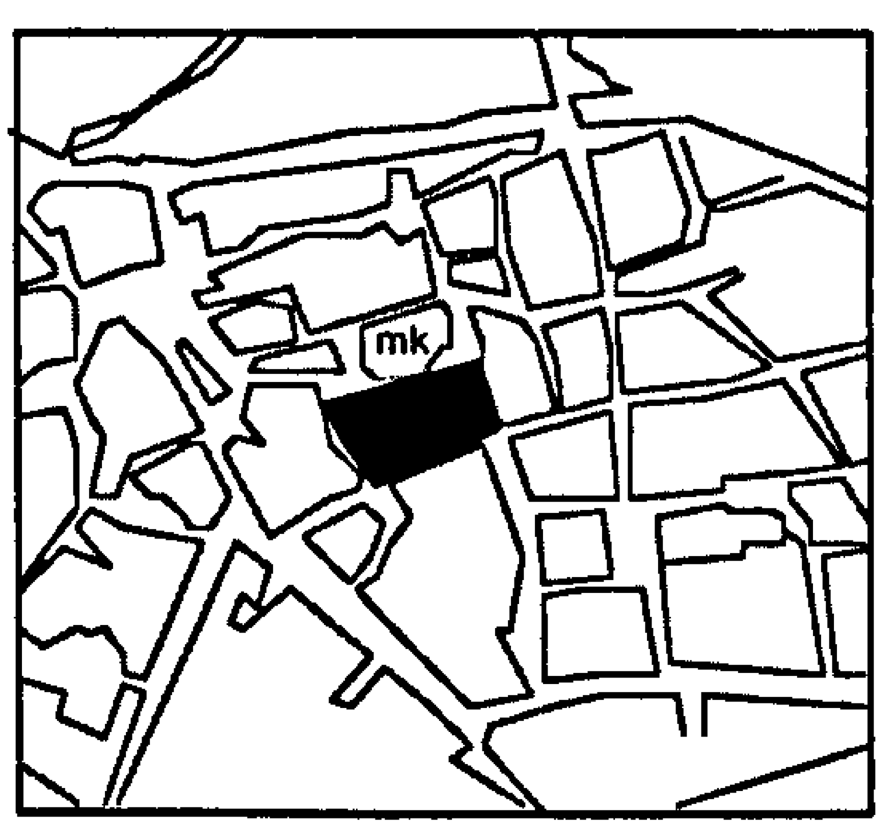


Kutna Hora - Czech Republic

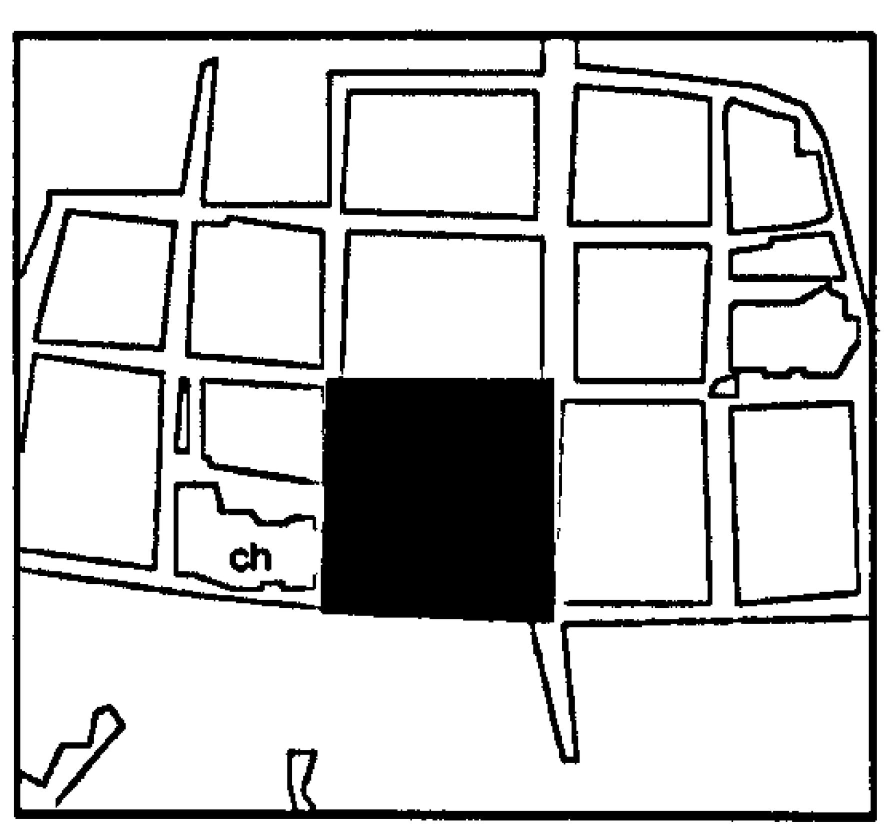
ch = church building ▬ main convex element

Figure 3.3. Example of a church square

Figure 3.4. Example of a main square



Esslingen - Germany



Klatovy - Czech Republic

mk= market area ▬ main convex element

Figure 3.5. Example of a market square

Figure 3.6. Example of a civic square

3.3.2.2. Degree of regularity of the urban grid

All urban squares were further grouped, according to the regularity of the urban grid, as "organic", "semi-regular" or "geometric". This was done according to the morphological characteristics of the urban grid, rather than of the urban square itself, as far as the geometric regularity was concerned. Again, it is important to stress that this classification according to the level of regularity of the urban grid is not definitive but merely a preliminary attempt to capture some immediate visual properties of the urban grid. A similar problem is faced here to that encountered with the earlier attempt to define the functionality of the urban square, in that the terms turned out not to be mutually exclusive and that sometimes it was difficult to establish, for instance, if a grid should be characterised as organic or semi-regular. Therefore, again, the classification will be used essentially as a heuristic device.

By "organic" one understands a deformed grid (Fig. 3.7). In this type, little symmetry, formal regularity or axial organisation can be detected. A "semi-regular" grid represents a certain geometric regularity of the urban fabric but it cannot be characterised either as a purely organic or a purely geometric street system (Fig. 3.8). Finally, the term "geometric" relates to a gridiron street system, where there is a clear symmetry, regularity and axial organisation (Fig. 3.9).

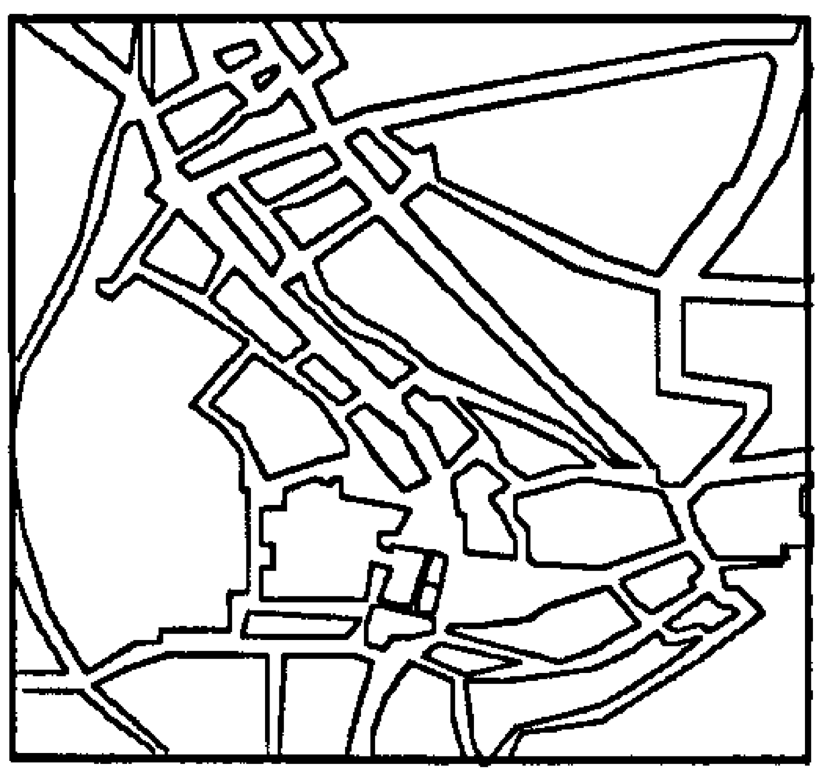


Figure 3.7. Example of an organic grid

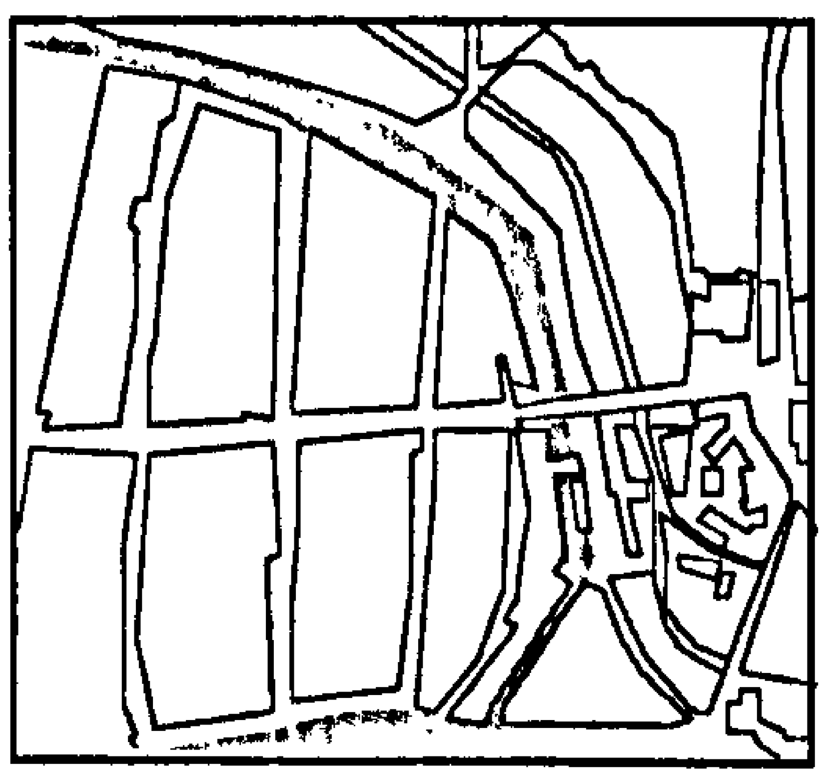


Figure 3.8. Example of a semi-regular grid

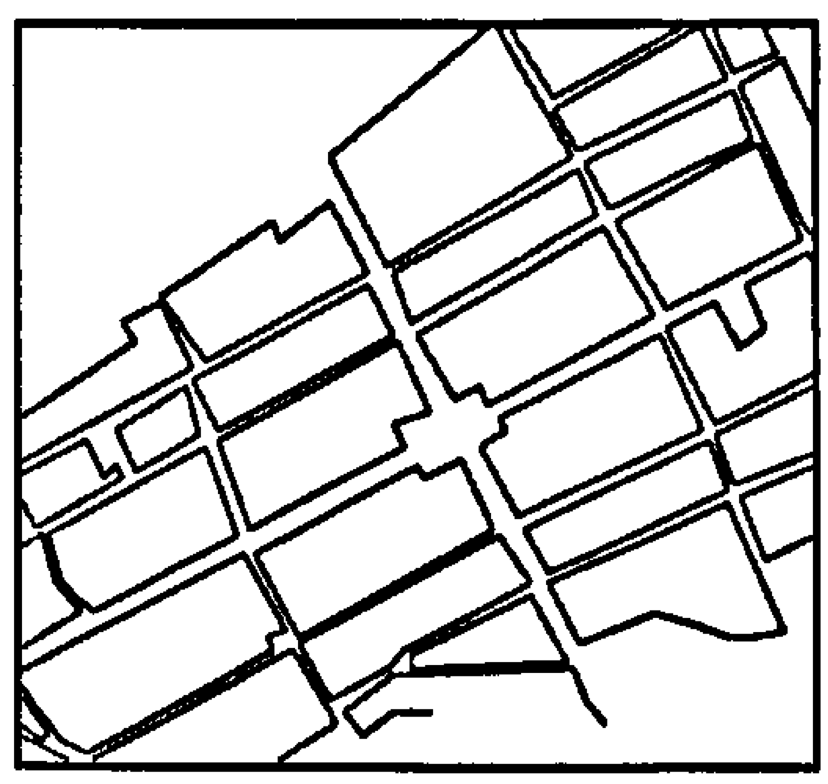


Figure 3.9. Example of a geometric grid

Having selected the sample and before embarking on the analysis of the isovists and convex elements, interfacing axial lines and embedding properties, the first step is to sort the data according to these two initial typological criteria, to see how the selected set of 30 urban squares is composed.

The data showed that, as far as the social function is concerned, market and main types of urban squares represent the great majority, accounting for 80% of the cases.

With regard to the urban grid, organic and semi-regular squares comprise more than 85% of the data. The data also show two towns where the area of the main element defining the urban square is much larger than in the other cases of the sample[12]. This shows that the sample, originally selected at random from the available plans, divides naturally into two sub-sets. The first sub-set consists of the dominant cases according to the function and degree of regularity of the urban grid. They are the market and the main urban squares located in organic and semi-regular types of urban grids with areas below 12000 m^2. It is constituted by 16 urban squares and it will be referred to from now on as the "core sample"[13].

The remaining 14 examples will be used to verify whether or not the properties identified in the core sample are valid for the more generalised sample comprising the original 30 towns. This will, from now on, be referred to as the "whole sample". The distinction is reflected in the numbering system for the figures that illustrate this chapter. Towns numbered from 1 to 16 are the ones that belong to the core sample. Towns from 17 to 30 are the complementary ones that compose, along with towns 1 to 16, the whole sample.

Table 3.5 gives a summary of the data according to the dominant social function and degree of regularity of the urban fabric. Tables 3.1 to 3.4, which give all the information used in the analysis, are found in Appendix 1.

	Description	Whole sample number of cases	Whole sample percentage	Core sample number of cases	Core sample percentage
Total number of cases		30	100	16	100
Function	Church	2	7	0	0
	Main	17	57	11	69
	Market	7	23	5	31
	Civic	4	13	0	0
Regularity	Organic	14	47	12	75
	Semi-regular	9	30	4	25
	Geometric	7	23	0	0

Table 3.5. Summary table according to regularity, function and convexity properties

12 They are: Groningen and Litomerice. The area of the main convex element defining the urban squares will be discussed in detail in Section 3.4.1.

13 The towns that compose the core sample are: Bruges, Caernarvon, Esslingen, Evora, Heilbronn, Kempten, Kutna Hora, Magdeburg, Moguer, Nijmegen, Palencia, Pest, S. Gimignano, Salisbury, Verdun and Võlkermarkt. The complementary towns are: Borgomanero, Brive, Castellon de la Plana, Groningen, Gyor, Kalisz, Klatovy, Litomerice, Modena, Montauban, Portalegre, Scarperia, Wielun and Wolfsberg.

3.3.3. REPRESENTATION AND QUANTIFICATION OF MEASURES

The description of the family of measures will be introduced according to the three types of analysis, that is, the convex and isovist analysis, the interfacing axial lines and the embedding analysis.

3.3.3.1. Convex and isovist analysis

Six measures are employed in the convex and isovist analysis. The metric area of the main convex element, as defined before, the metric area of their respective convex isovists, the sum of isovist lengths, the mean sum of isovist lengths, the visibility ratio and the enclosure ratio, as follows:

The convex isovists were studied as potential major elements in the morphology of urban squares, due to the importance that has already been established of the visual links between the urban square and its exterior, in so far as the information that we obtain visually as we walk around helps us to form a global picture of how the wider spatial system is structured. For example, Hillier (1993 and 1996), reporting the work of Marios Pekelanos on Roman squares[14], described how important it is to the spatial structure of Rome to realise that the isovists of its constituent urban squares inter-link to one other. Hillier points out, "We immediately see how mistaken we would be to see Roman squares as local elements. The isovists show they also form a global pattern" (Hillier, 1996, p156). Furthermore, if we conjecture that in medieval times much of the daily trade took place in urban squares, as suggested by historians[15], passers-by could have been important for their survival. It is easy to imagine that the more people were aware of their existence, the more people were likely to visit the place.

The convex isovist studied here is defined as the set of all points visible from within the main convex element defining the urban square with respect to the environment, excluding the main convex element itself. Figure 3.10 illustrates this. The light areas represent the convex isovist (which will be the sum of all branches) and the dark one the main convex element. The main convex elements and their respective convex isovists for all 30 cases are shown in Plate 3.3, Appendix 1. In addition, the length of

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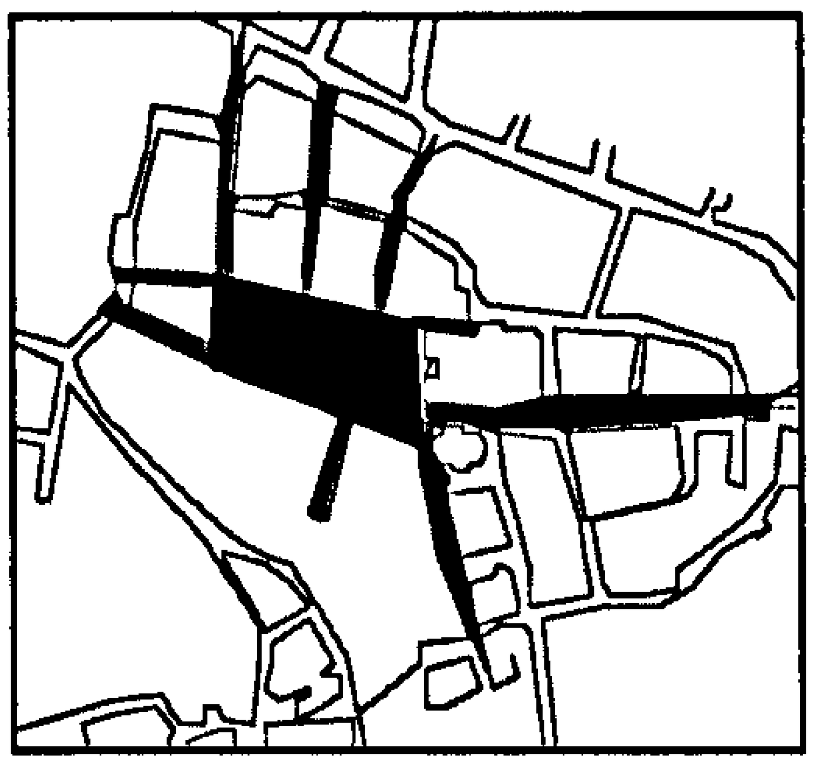
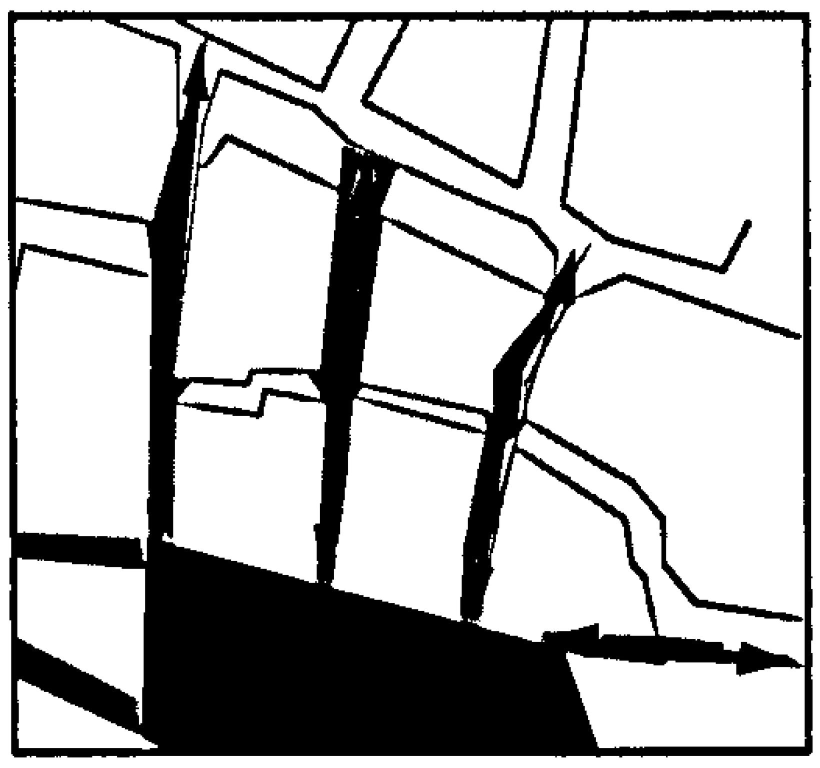
[14] Marios Pekelanos, MSc student in the Advanced Architectural Studies Programme at the Bartlett School of Graduate Studies, did the original study on Roman squares, UCL, in 1989.

[15] See Benevolo, 1980; and Morris, 1994.

the isovist was also measured. The length of isovist was measured to see how far the visual links extend away from the urban space, and it was defined by the sum of the longest straight direct line covering all the different branches of a convex isovist, as highlighted by the arrows in Figure 3.11. The mean sum of the isovist is defined by the sum of isovist length divided by the respective number of branches. The mean of the sum of the lengths was investigated in order to minimise the effect of a relatively short isovist but with many branches in comparison to an isovist with few but very long branches. Finally a visibility ratio is proposed, which is defined by the area of the convex isovist divided by the area of the respective main convex element.





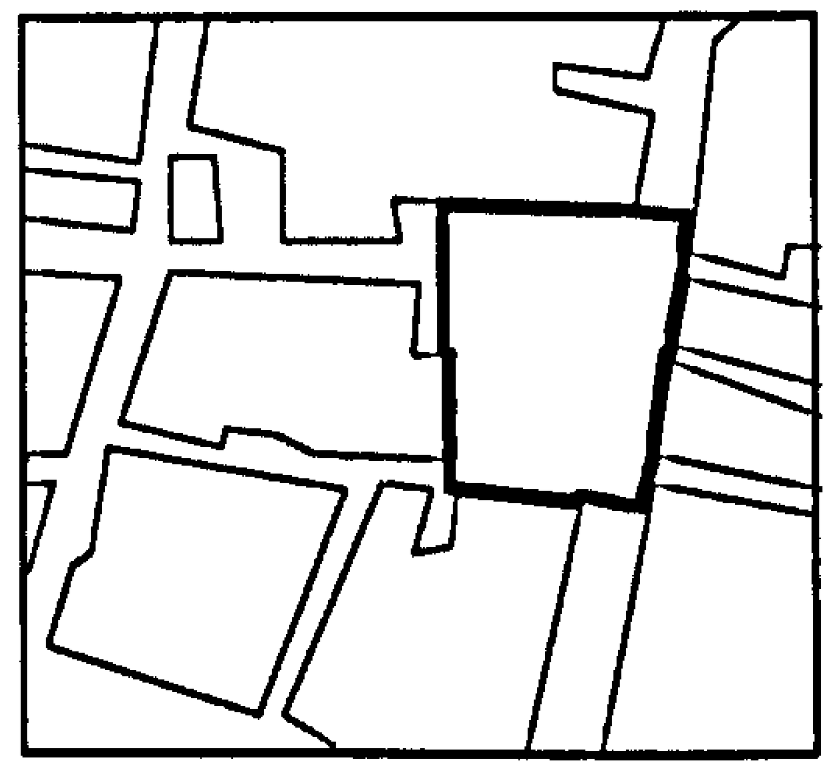


Figure 3.10. Convex isovist field

Figure 3.11. Measurement of the length of convex isovists

Figure 3.12. Enclosure ratio

"Enclosure ratio" is the last measure to be introduced in this section. In order to investigate how far enclosure is a spatial property of traditional squares as discussed previously, an enclosure ratio is proposed. The enclosure ratio (ER) is defined by the division between unbuilt (light grey lines) and built perimeter[16] (black lines) derived from the interface between the convex element defining the urban square and the surrounding buildings, as shown in Figure 3.12.

3.3.3.2. Interfacing axial lines analysis

Nine measures are used in the interfacing axial lines analysis. In addition to the metric area of the main convex element, the axial lines that interface with the main convex element are analysed according to: the number of axial lines, the sum of the length of the axial lines, the mean of the sum of the length of the axial lines, local (R3) and global (Rn) integration values of the axial lines, strategic value, the local strategic value

[16] The definition of a perimeter is the length of the outer edge of a closed geometric shape (Oxford Dictionary).

and intersection points. The lengths of the axial lines were measured[17] with the results presented in metres. The sum of the length of the axial lines refers to the sum of the metric length of the axial lines used for the analysis. The mean of the sum of the length of the axial lines is the sum of the (metric) length of the axial lines divided by the number of axial lines.

The local and global integration values of the axial lines were quantified as described in Section 2.4.2 (Chapter 2). The strategic value and intersection points will be described further in this section. In addition, the axial lines used for the morphological analysis are classified according to the way they intercept the main convex element, as explained below.

Hillier (1984), in his analysis of urban squares suggested a distinction between types of axial lines. There are the axial lines that go through the body of the urban square and the ones that are adjacent and therefore do not cross or intercept the urban square at any moment but are "visible" from it (refer to Figure 2.12, Chapter 2).

Preliminary inspection of the axial structure of the traditional urban squares of the sample (Plate 3.4, Appendix 1) showed that while there are a good number of axial lines interfacing with the main convex element, there is apparently a substantial number of axial lines that terminate inside the space. It is then conjectured that a further distinction according to the way they interface with the public squares might be illuminating, adding a new category of axial lines to the two originally discussed by Hillier. This investigation makes a distinction between the axial lines that interface with the urban square and terminate within its defined spatial limit, the main convex element, and those that continue, in addition to the lines that pass adjacent to the urban square. This refines and clarifies the precise way in which axial lines can be divided into different categories according to the way they approach the urban square. The tripartite classification reflects the type of pedestrian movement the axial lines might be expected to be associated with, that is, "to-movement", "through-movement"[18] or "by-pass-movement" (defined next) and it is hypothesised that this distinction will be relevant when analysing the syntactic properties of public spaces in relation to pedestrian movement and static occupation.

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[17] The lengths of the axial lines, likewise the areas of the main convex element, were measured through a Minicad version 6.0 computer aided design software program.

[18] The terms "to-movement and through-movement" were previously used by Hillier, et al., 1987a, p237.

• Convergent (C): Were defined as the axial lines that cross the main convex element and terminate within the main convex element[19]. If the axial line ends outside the convex space but at the building façades surrounding the urban square, it will still be classified as a convergent axial line, as long it does not interface with any other axial line that does not interface with the main convex element. A circle in the example (Fig. 3.13) highlights this. We associate these lines hypothetically with "to-movement" and to single vistas, as visual fields will be limited to one direction only. In fact, this distinction may also show important evidence on the extent of visual links and therefore of the possible dynamics of space awareness.

• Transverse (T): Transverse axial lines were defined as the axial lines that cross the main convex element and continue further away, outside the spatial boundaries of the main convex element and intersect with other axial lines. We associate these lines hypothetically with "through-movement" since they suggest continuity in contrast to convergent axial lines that suggest termination[20]. In this case, the isovists will be extended in two directions. A typical case is shown in Figure 3.14.

• Peripheric (P): The peripheric axial lines are the ones crossing the main convex element and which continue further away, but, in this case, the axial line is located at the edges of the main convex element. This differentiation between transverse and peripheric axial lines was made necessary because of the spatial definition of the main convex element. The peripheric axial lines mainly reflect the lines that are associated with the roads that run parallel to an urban square, but because of the present definition of the spatial limits, the lines will actually be going through it. We associate these lines with "by-pass-movement" and the isovists will be extended in two directions. A typical case is shown in Figure 3.15.

[19] In Figures 3.13, 3.14 and 3.15 which illustrate examples of convergent, peripheric and transverse axial lines, the axial lines shown in the diagrams are only the ones interfacing with the main convex element.

[20] Refer to Hillier, 1996, p220.

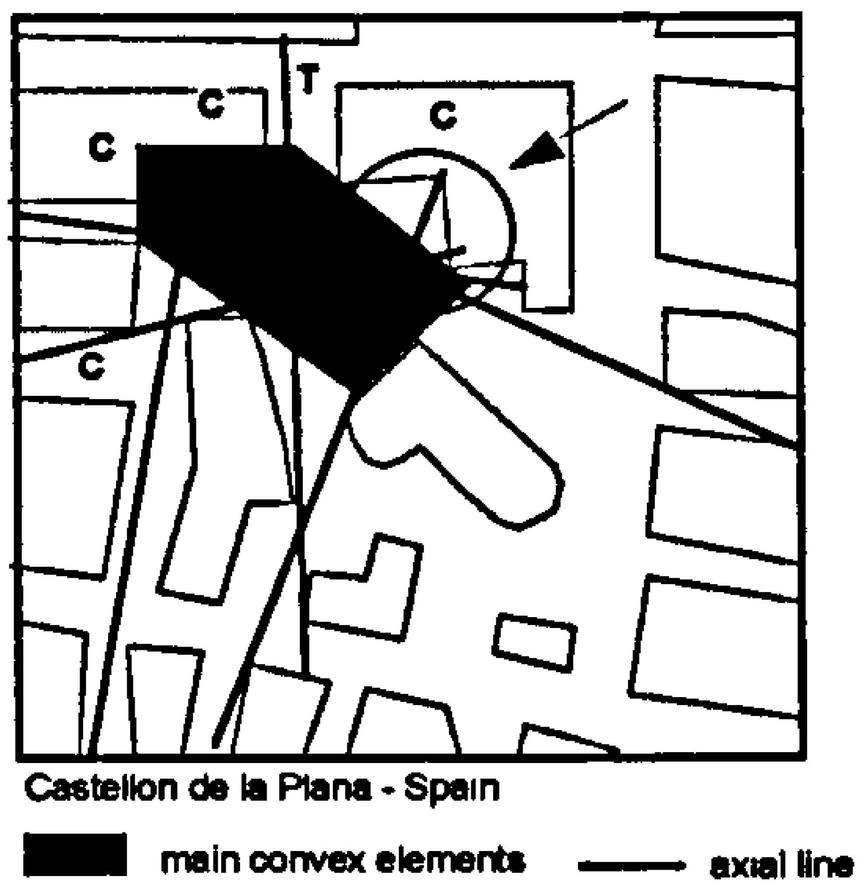

Figure 3.13. Example of convergent axial line

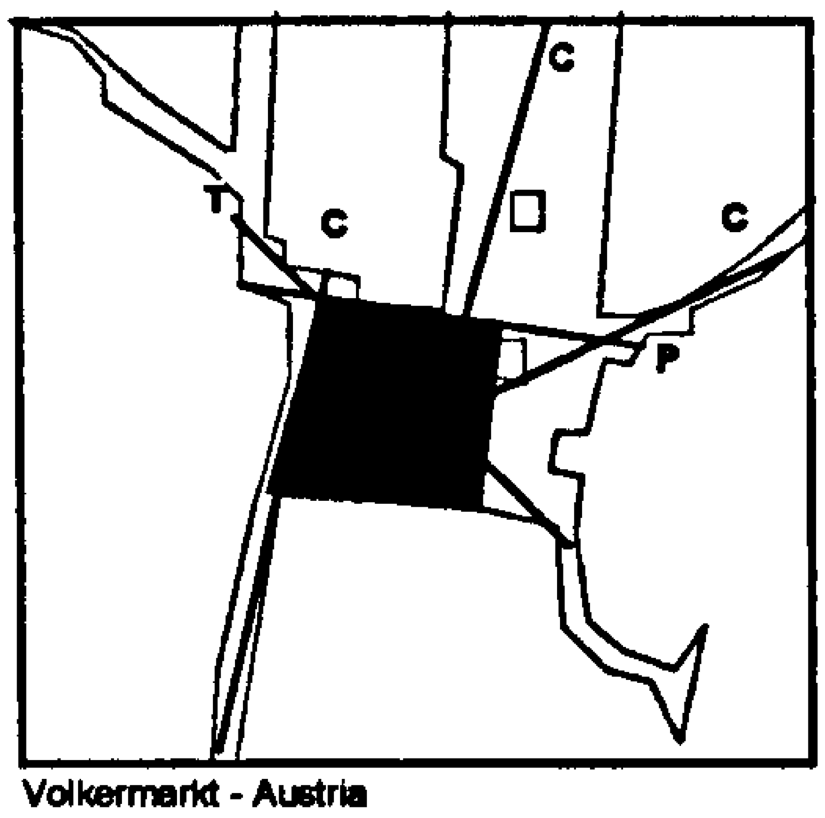

Figure 3.14. Example of transverse axial line

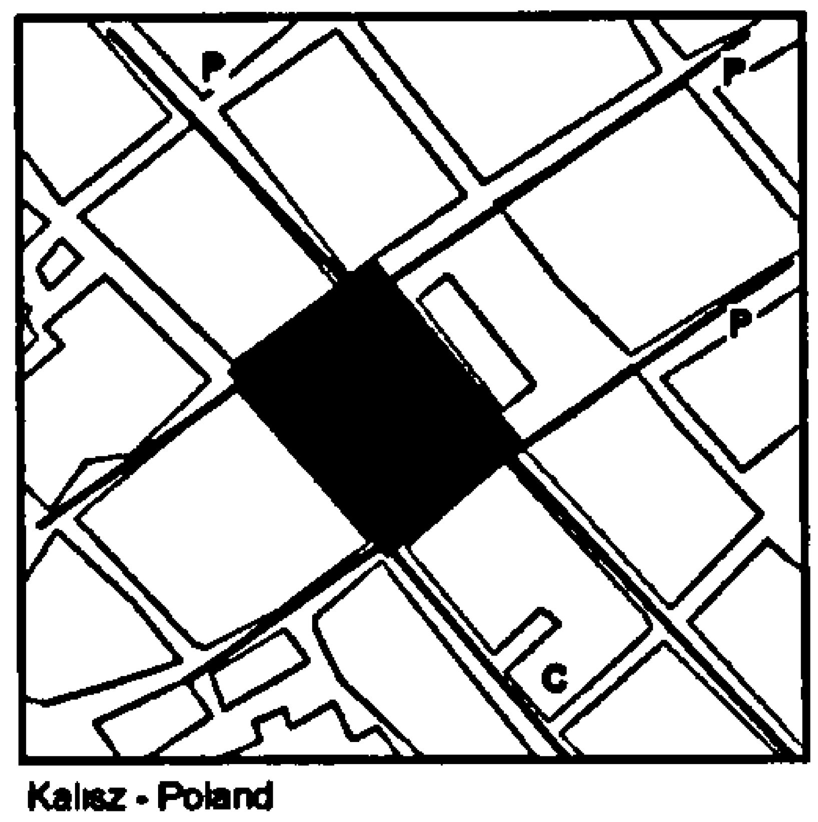

Figure 3.15. Example of peripheric axial line

Therefore, regarding the strategic value, there is a slightly different interpretation when using the strategic value for the present analysis compared with that originally defined by Hillier (1984). In Hillier's definition, the peripheric axial lines are not part of the strategic value because they will be adjacent to the urban square since they "follow" the adjacent streets and obviously do not intercept it. As for the present analysis the main convex element is defined by the building blocks, the surrounding "streets" becoming an integral part of the main convex element and therefore all three types are part of the strategic value. As discussed previously, in the case of the traditional examples, a distinction between streets and squares is likely not to be a truthful representation of reality. Therefore, for the present analysis the strategic value is defined by the sum of the global integration values of all axial lines (C, T and P lines) that interface with the main convex element.

In addition, to measure urban squares' strategic location at a more localised level, a "local" strategic value is introduced for the analysis. The local strategic value is defined by the sum of the local (R3) integration values of all axial lines that interface with the main convex element.

Plate 3.4 in Appendix 1 illustrates in detail the character of the interfacing axial lines in each of the 30 main convex elements, according to the classification into convergent (red), transverse (blue) and peripheric (green) axial lines.

3.3.3.2.1. Intersection points

From the literature review, it has been suggested that the preferred location for static people inside public spaces occurs near lines of pedestrian flow. Because generally much of the pedestrian flow happens in the adjacent streets, the static occupation follows an outside to inside pattern named the edge effect (Gehl, 1987). Therefore, as a prelude, the next step in this study is to investigate if the axial lines that interface with the main convex element have the property of clustering at intersection points and if there is a particular location where the axial lines intersect. Intersection points are defined as the intersection of two or more axial lines, as illustrated in Figure 3.16.

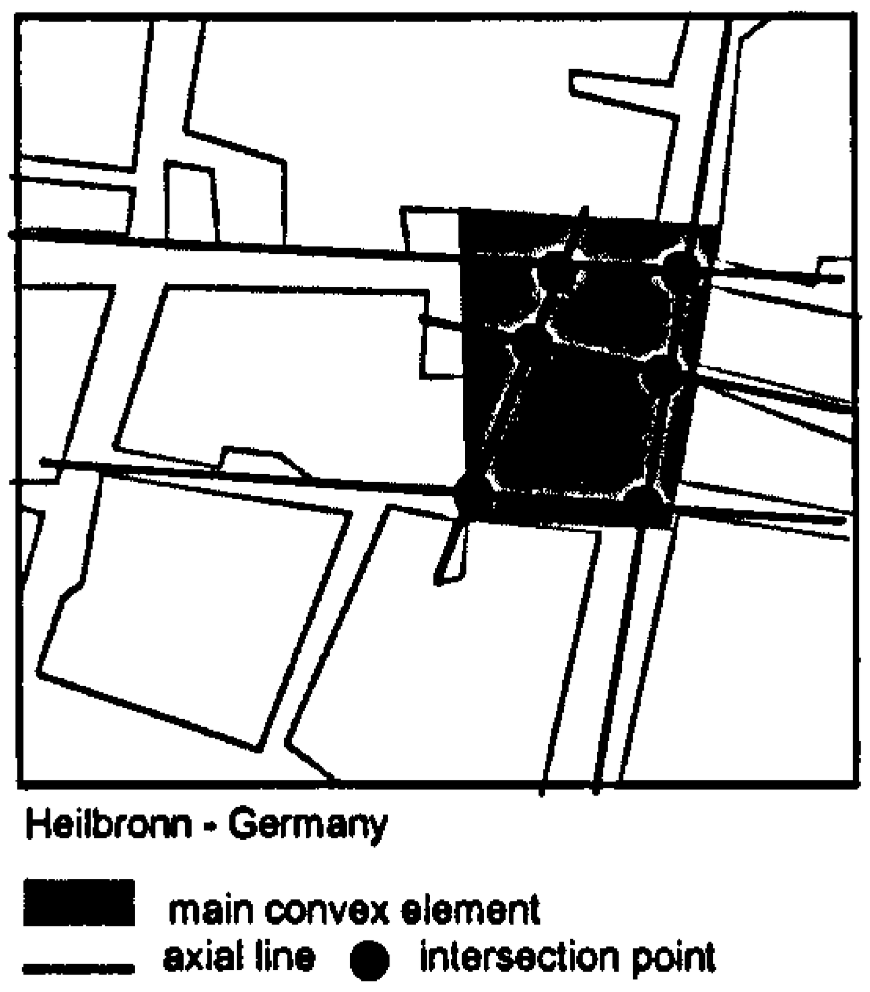

Figure 3.16. Example of intersection points

There was no tolerance as to whether intersection points close to each other could be synthesised in one. The axial break—up was carried out and at that first stage there was no previous knowledge of how many intersection points would exist and from how many lines would be made. Plate 3.5 in Appendix 1 shows the location of intersection points between axial lines for the 30 cases.

3.3.3.3. Embedding analysis

To study the strategic position of the urban squares with regard to the large scale structure of the urban fabric, they are analysed examining:

- The depth of the lines that interface with the main convex element with respect to the most globally integrated lines of respective towns.
- The integration values of the axial lines that interface with the main convex element in relation to the 10% most integrated lines of their respective towns, which define the 10% integration core.
- The global integration value of the main convex element in relation to the global integration values of the axial lines of its urban context.

Depth is defined by how many steps the axial lines that interface with the main convex element are from the most integrated line of respective town. The 10% most integrated axial lines of the system define the "main integration core". In other words, the concept of an integration core refers to the 10% of spaces which are more easily accessible to the urban layout as a whole at local and global levels[21]. The global integration value for the urban square was measured using the radius-n integration axial break-up map. The value was calculated by drawing an axial line that intersects all the lines that interface with the main convex element and by having the integration values re-calculated. Plate 3.6, next page, shows the location of each main convex element defining the urban square in the global integration axial map of respective towns.

3.3.4. THE STATISTICAL ANALYSIS

Statistical analysis techniques have been used to understand and explore the fundamental relationships between the different parameters measured for the morphological analysis of public spaces, and to determine which of these factors are most significant in predicting the public space performance. A brief description of the key techniques used throughout this thesis is now described.

Regression analysis is the standard technique used to predict a single dependant variable from the knowledge of one or more independent variables. When the analysis involves a single independent variable, it is known as "simple regression". In the case of two or more independent variables, it is referred to as "multiple regression" analysis.

In this work we are evaluating the linear relationship between the different attributes measured for the morphological analysis of public spaces. A linear regression simply means that the functional relationship between y (the dependant variable in the vertical axis in scattergrams) and x (the independent variable in the horizontal axis) can be expressed by a linear equation. In the case of simple regression, the relationship can be expressed by the equation below[22]:

$$Y = b_0 + b_1X$$

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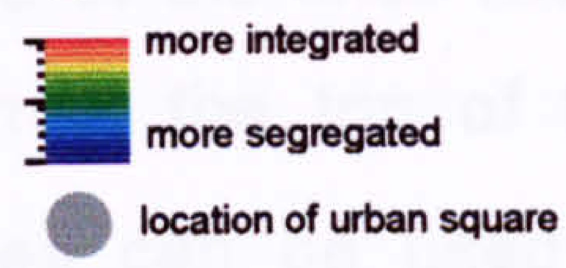
[21] See Hillier et al., 1978b, p227.

[22] Hair, J. et al. (1992) *Multivariate Data Analysis with Readings*. New York: Macmillan Publishing Company.

Plate 3.6. European towns global integration maps



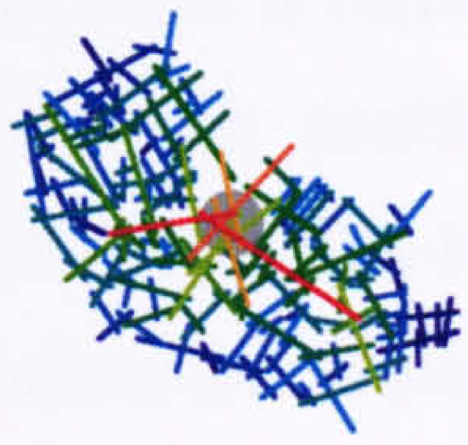


Fig. 1. Brugges - Belgium

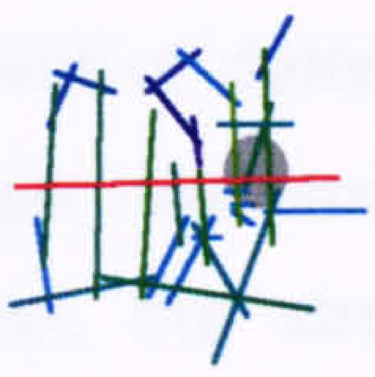


Fig. 2. Caernarvon - UK

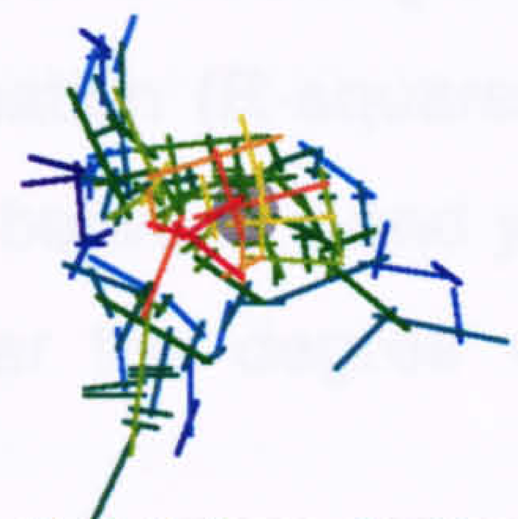


Fig. 3. Esslingen - Germany


Fig. 4. Evora - Portugal

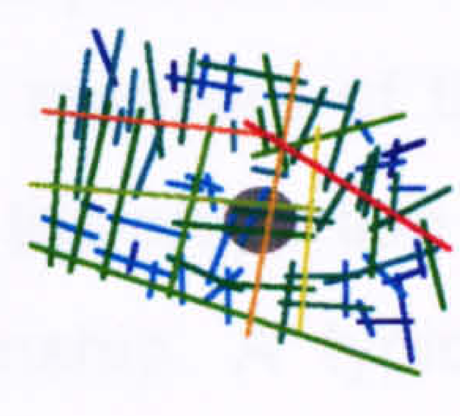


Fig. 5. Heilbronn - Germany


Fig. 6. Kempten - Germany

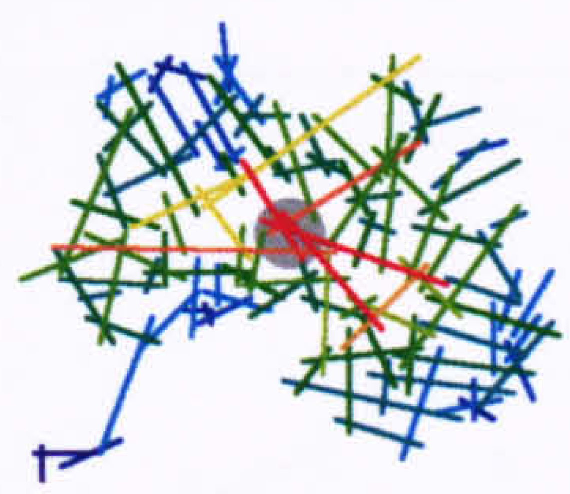


Fig. 7. Kutna Hora - Czech Republic


Fig. 8. Magdeburg - Germany


Fig. 9. Moguer - Spain


Fig. 10. Nijmegen - Netherlands


Fig. 11. Palencia - Spain


Fig. 12. Pest - Hungary


Fig. 13. San Gimignano - Italy


Fig. 14. Salisbury - UK

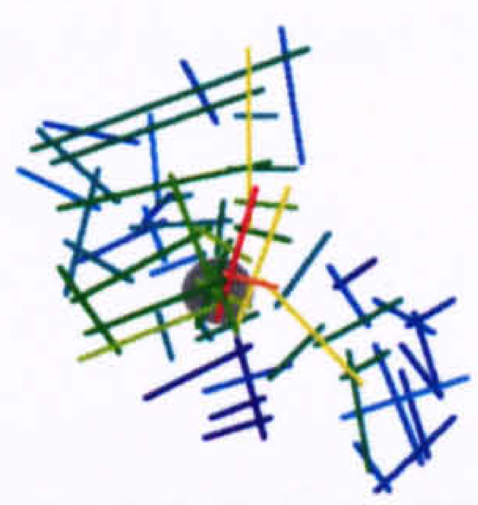


Fig. 15. Verdun - France

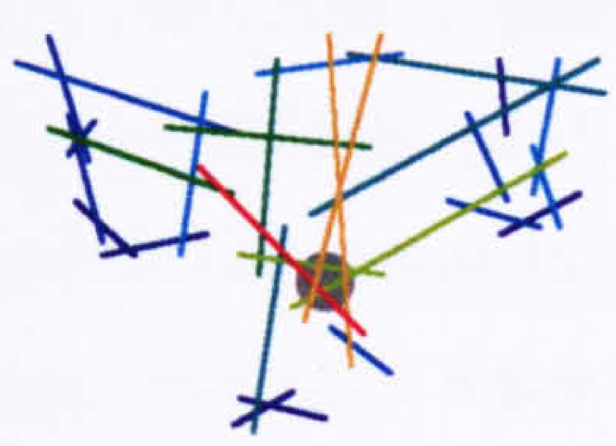


Fig. 16. Volkermarket - Austria

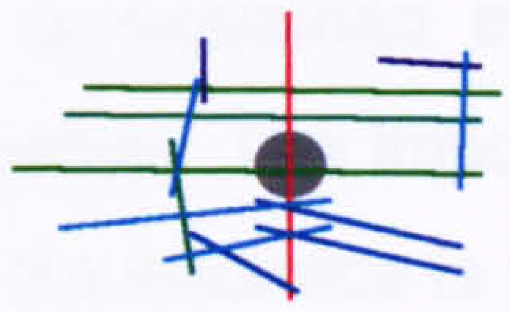


Fig. 17. Borgomanero - Italy


Fig. 18. Brive - France


Fig. 19. Castellon de la PLana - Spain


Fig. 20. Groningen - Netherlands


Fig. 21. Gyor - Hungary


Fig. 22. Kalisz - Poland

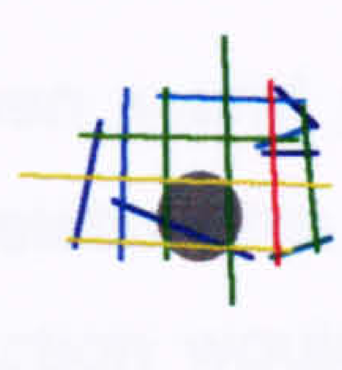


Fig. 23. Klatovy - Czech Republic

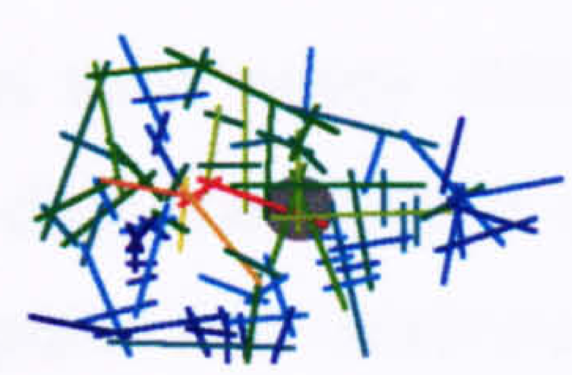


Fig. 24. Litomerice - Czech Republic


Fig. 25. Modena - Italy


Fig. 26. Montauban - France

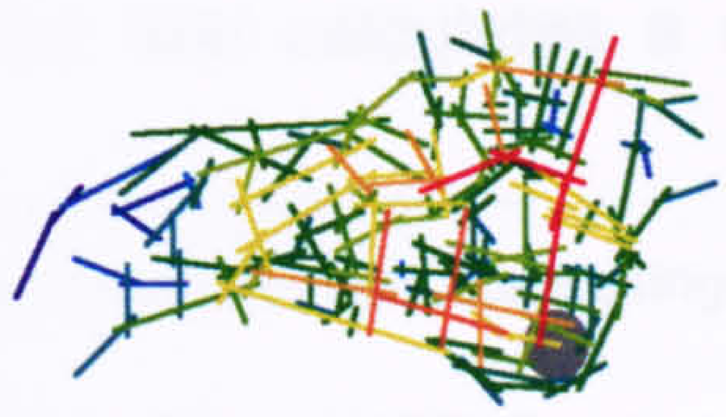


Fig. 27. Portalegre - Portugal

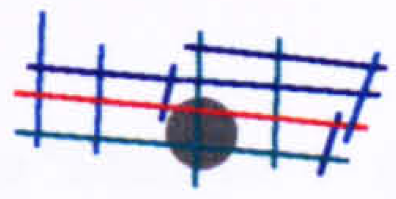


Fig. 28. Scarperia - Italy


Fig. 29. Wielum - Poland

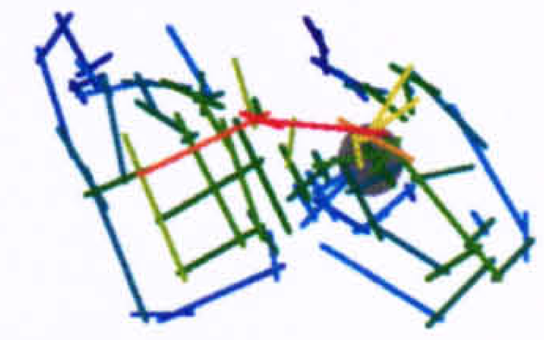


Fig. 30. Wolsfsberg - Austria

Where "b_0" is the intercept on the "Y" axis and "b_1" is the slope of the line. These parameters are known as the regression coefficients (shown at the top of the scattergrams). Using a mathematical procedure[23], these values can be used to calculate a regression line shown in a scattergram. The regression analysis calculates the linear coefficient of determination (R-squared value), which is a measure of the strength of the linear relationship between x and y values. The greater the proportion of explained variation, the stronger the degree of the linear relationship. A typical example is shown in Figure 3.17.

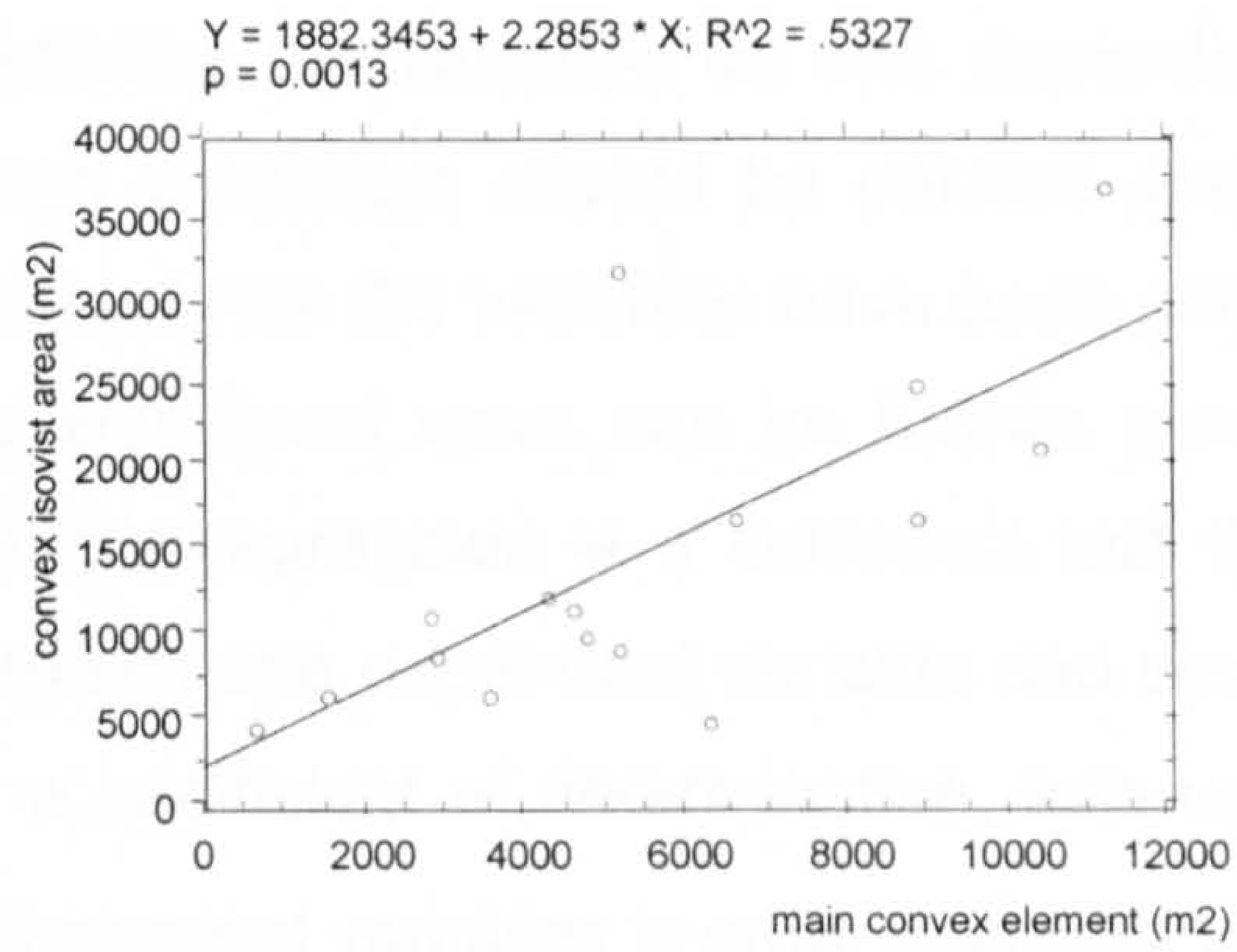


Figure 3.17. Regression analysis

In the example where the area of the main convex element is plotted against the area of their respective convex isovists the even distribution of points along the regression line indicates a good linear relationship. The R-squared = 0.5327 means that 53% of the variability of Y is explained by X. The regression analysis also calculates a probability value (p-value). The importance of the p-value is that it enables us to judge how strong or weak the evidence is to support the results, where the smaller the value, the stronger the evidence. Results with probabilities of more than 0.05 are generally not considered because they are regarded as statistically insignificant[24].

The functional relationship between x and y can take many different forms. In the cases where there was no linear relationship, the data was further analysed to explore if a logarithmic or polynomial function would explain the relationship. For situations when there was doubt about the association between dependant and independent variables, the non-parametric Kendal rank correlation test was applied. The Kendal rank-correlation test calculates a correlation coefficient based on the ranks of the

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23 All the statistical analysis was done using the "Statview 4" software.

24 Chase, W. and F. Brown (1992) *General Statistics*. New York: John Wiley & Sons, Inc., p331.

values of two variables. The results are expressed by the Tau corrected for ties and a p-value. The Tau corrected for ties value varies from -1 to 1. A value close to 1 indicates a positive agreement between X and Y, -1 indicates that the ranks of Y are in opposite order to the ranks of X. A value close to zero indicates that X and Y are independent. Likewise, for regression analysis, p should be < 0.05 for the results to be statistically significant.

Stepwise regression is a statistical technique used to sort from a large number of independent variables which one(s) are significant (and which not significant) in predicting the variation for one dependent variable. The results are given by listing which predictors should be deleted and which should be added to the regression model. Once the variables have been sorted through the stepwise regression analysis, the significant ones can be further analysed through multiple regression analysis. Multiple regression is a statistical test that can be used to analyse the relationship between one dependent variable and several independent variables. The result, given by a coefficient of determination, tells us how strong the relationship is between the independent variables in order to predict the values for the dependent variable[25].

Finally, a test of significance (the t-test) was used to investigate whether there is a significant variation between the mean of a small sub-set of data in relation to the mean value of a whole sample. The t-test determines the likelihood that the observed difference between the mean of the sub-set and the mean of the whole sample occurred by chance. The degree to which the two averages differ is indicated by a t-value where values greater to 1 (positive or negative) indicate a difference. The probability that this could have happened by chance is reported by the p-value[26] as before. The t-test can be calculated by comparing the average value for a sub-sample to the average for the entire data set excluding or not the sub-sample elements.

[25] Statview Version 4 User Manual and Data Desk Version 5 User Manual.

[26] Statview Version 4 User Manual (no date), Chapter 13.

3.4. THE MORPHOLOGICAL ANALYSIS

The three types of analysis referred to earlier, convex and isovist analysis, interfacing axial lines analysis and embedding analysis, will now be presented following first the core sample, then the whole sample and for different individuals and groups of squares according to the social function or regularity of the urban grid whenever relevant.

3.4.1. CONVEX AND ISOVIST ANALYSIS

This section investigates the visual and access links between the urban square and its surroundings through an analysis of the main convex element and isovist properties. In this respect, not only was the area of the main convex element measured, but also their respective isovist areas and length. In addition, visibility and enclosure ratios in the terms defined in Section 3.3.3.1 are employed. Table 3.6, next, gives the data used for the analysis. The results of the analysis will be discussed first for the core sample and then for the whole sample.

Towns	Sample	Regularity of urban fabric	Function of urban squar.	Main convex element area m2	Isovist area m2	Visibility ratio	Enclosure ratio	Sum isovist length	Mean sum isovist length
Bruges	core and whole	organic	main	10442	21090	2.02	2.06	1532.90	153.29
Caernarvon	core and whole	semi-reg.	main	659	4540	6.89	1.11	535.50	89.25
Esslingen	core and whole	organic	market	4792	9572	2.00	1.26	661.92	94.56
Evora	core and whole	organic	main	6660	16800	2.52	1.43	1318.2	146.47
Heilbronn	core and whole	semi-reg.	market	4292	12138	2.83	1.54	909.95	129.99
Kempten	core and whole	organic	main	4588	11292	2.46	1.88	540.34	105.07
Kutna Hora	core and whole	organic	main	5168	9122	1.77	1.48	493.92	98.78
Magdeburg	core and whole	organic	market	11230	36645	3.26	0.65	1537.20	128.10
Moguer	core and whole	organic	main	1590	6310	3.97	1.39	628.58	125.72
Nijmegen	core and whole	organic	main	2894	8490	2.93	1.45	572.46	114.49
Palencia	core and whole	organic	main	6324	4704	0.74	4.02	233.49	58.37
Pest	core and whole	organic	main	8900	24812	2.79	1.28	1086.60	155.23
S. Gimignano	core and whole	organic	main	3563	6392	1.79	2.08	537.97	53.80
Salisbury	core and whole	semi-reg.	market	8900	16847	1.89	1.21	842.16	140.36
Verdun	core and whole	organic	main	5187	31602	6.09	1.45	1443.90	180.49
Volkermarkt	core and whole	semi-reg.	market	2848	10948	3.84	0.91	449.41	112.35
Borgomanero	whole	geometric	main	1680	13328	7.93	1.39	843.76	210.94
Brive	whole	organic	church	2340	6043	2.58	2.83	639.40	106.57
Castellon	whole	semi-reg.	civic	3438	10128	2.95	0.39	686.98	98.14
Groningen	whole	semi-reg.	main	27075	63512	2.35	1.99	1827.40	203.05
Gyor	whole	geometric	market	7518	22446	2.99	1.80	1618.30	161.83
Kalisz	whole	geometric	market	4340	11724	2.70	1.71	897.36	128.19
Klatovy	whole	geometric	civic	9904	15774	1.59	3.11	1043.0	130.38
Litomerice	whole	semi-reg.	main	17720	29878	1.69	3.12	1359.60	151.07
Modena	whole	organic	civic	5116	25420	4.97	0.34	1247.50	155.94
Montauban	whole	geometric	main	5316	16092	3.03	1.37	894.50	111.81
Portalegre	whole	semi-reg.	civic	4104	12176	2.97	1.55	819.99	136.67
Scarperia	whole	geometric	main	1140	5516	4.84	1.97	694.68	115.78
Wielun	whole	geometric	main	3870	5418	1.40	2.30	453.43	113.36
Wolfsberg	whole	semi-reg.	church	600	1376	2.29	1.93	123.40	30.85

Table 3.6. Convex and isovist analysis data

The analysis of the core sample showed that the average area for the main convex element is 5502 m^2, ranging from 659 to 11230 m^2. The area of isovists has an average of 14457 m^2, ranging from a little more than 4500 to almost 37000 m^2. The sum of isovist lengths is 833 metres and the mean sum of isovist lengths 118 meters. Most significantly, the areas of isovists, which were measured to assess the breadth of their visual properties, are, on average, approximately three times the area of their respective main convex elements (the visibility ratio). The mean enclosure ratio for the core sample is 1.57, varying from 0.65 to 4.02, with only one case where the amount of unbuilt perimeter was greater than the built perimeter[27].

When the analysis was extended to the whole sample, with all the 30 examples included, the pattern of the previous results prevailed in all aspects. The mean area for the main convex element (6073 m^2), isovists (15671 m^2), sum of isovist lengths (882 m), mean sum of isovist lengths (125 m) visibility ratio (3.07), and finally the enclosure ratio (1.70, varying from 0.34 to 4.02), as illustrated in Table 3.7, next, are very close to the results obtained for the core sample, with no statistically significant variation between the core and the whole sample for the six measures previously discussed, confirmed using t-test analysis[28].

The information was then broken down according to the likely social function and geometry of the urban grid and this showed that, again, the overall pattern was maintained with one exception for the church squares. The main convex element of church squares initially showed smaller compared to the other types. However, a closer analysis showed that the opposite is the case. As described under Section 3.3.2.1, church squares were selected by taking the largest convex element around a church building. When considering the whole space including the church building and all the open areas surrounding it, the average area for church squares is 5090 m^2, therefore matching the whole sample, and the same result also applies for the areas of isovists. Table 3.7, next, gives a summary of the results of the analysis.

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[27] The results for the non-core sample (the remaining 14 cases) are: mean area for the main convex element (6726 m^2), isovists (17059 m^2), sum of isovist lengths (939 m), mean sum of isovist lengths (132 m), visibility ratio (3.16) and enclosure ratio (1.84).

[28] The results are: main convex element area: $t = 0.519$ with $p = 0.5673$; isovist area: $t = 0.527$ with $p = 0.602$; sum of isovist length: $t = 0.625$ with $p = 0.5367$; mean sum isovist length: $t = 0.925$ and $p = 0.3624$; visibility ratio: $t = 0.265$ with $p = 0.7926$ and enclosure ratio: $t = 0.829$ with $p = 0.3797$.

Category	Number of cases	Main convex element area (m2)	Convex isovist area (m2)	Sum of isovists lengths (m)	Mean of sum of isovists lengths (m)	Visibility ratio	Enclosure ratio
Core sample	16	5502	14457	833	118	2.99	1.57
Whole sample	30	6073	15671	882	125	3.07	1.70
Church	2	1470	3710	381	69	2.44	2.28
Main	17	6634	16406	882	129	3.25	1.87
Market	7	6274	17189	988	128	2.79	1.30
Civic	4	5640	15874	949	130	3.12	1.35
Organic	14	5628	15591	891	118	2.85	1.69
Semi-regular	9	7737	17949	839	121	3.08	1.53
Geometric	7	4824	12900	921	139	3.50	1.95

Table 3.7. Convex and isovist analysis summary results

Another aspect of this research is to study the relationship between the visual and access links between the public space and its surroundings by looking at how these properties are related to the size of the main convex element. The investigation started by testing if Hillier's (1988) conjecture, that the convex isovist area should be in proportion to the urban square area (as a way of creating enough visual and access links) can be applied to the generality of traditional urban squares. Also, the relationship between the urban square and the enclosure ratio is investigated, conjecturing the bigger the space, the bigger the immediate openings to the surroundings have to be, to enhance its visual and access links with the urban environment. As before, the results of the analysis will be presented first for the core sample and then for the whole sample.

The analysis of the scattergram for the area of the main convex element against the convex isovist area for the core sample showed a good linear correlation, as seen in Figure 3.18. Similarly, the data was analysed to see whether the sum of the length of isovists would also be significant. It proved so as illustrated in Figure 3.19. On the other hand, the data showed a very weak linear correlation between of the area of the main convex element and the mean of the length of isovists (Fig. 3.20). There are three cases (Verdun (1), S. Gimignano (2) and Palencia (3)) which do not follow the general trend of the sample, as analysed by the remaining points being well distributed along the regression line. However, these three cases do not have apparently any common distinct spatial elements that would characterise them as "belonging" to a special or independent category of urban squares. Regarding the analysis between the size of the main convex element and enclosure ratio, no correlation was found, as seen in Figure 3.21.

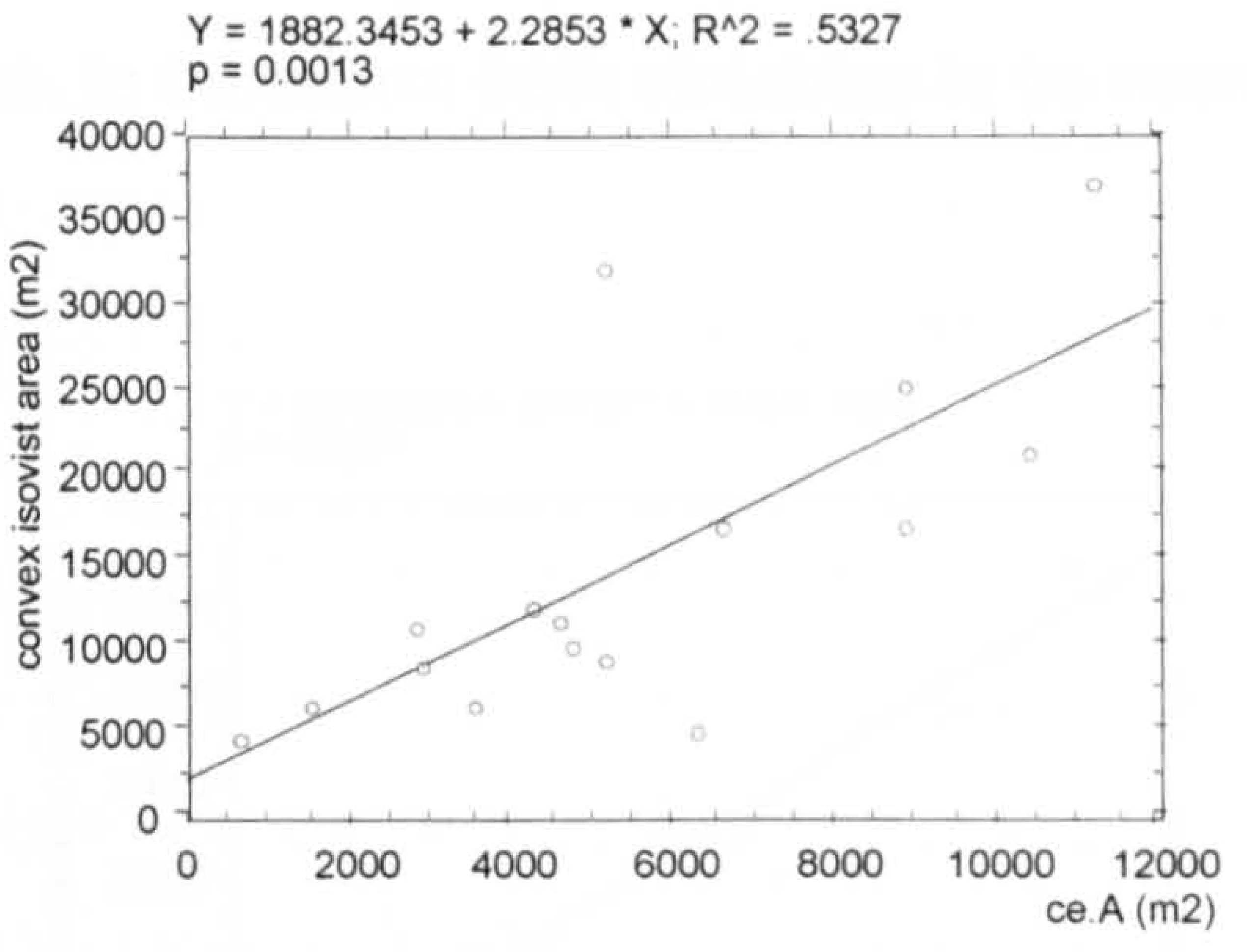

Figure 3.18. Scattergram main convex element area and convex isovist area, n = 16

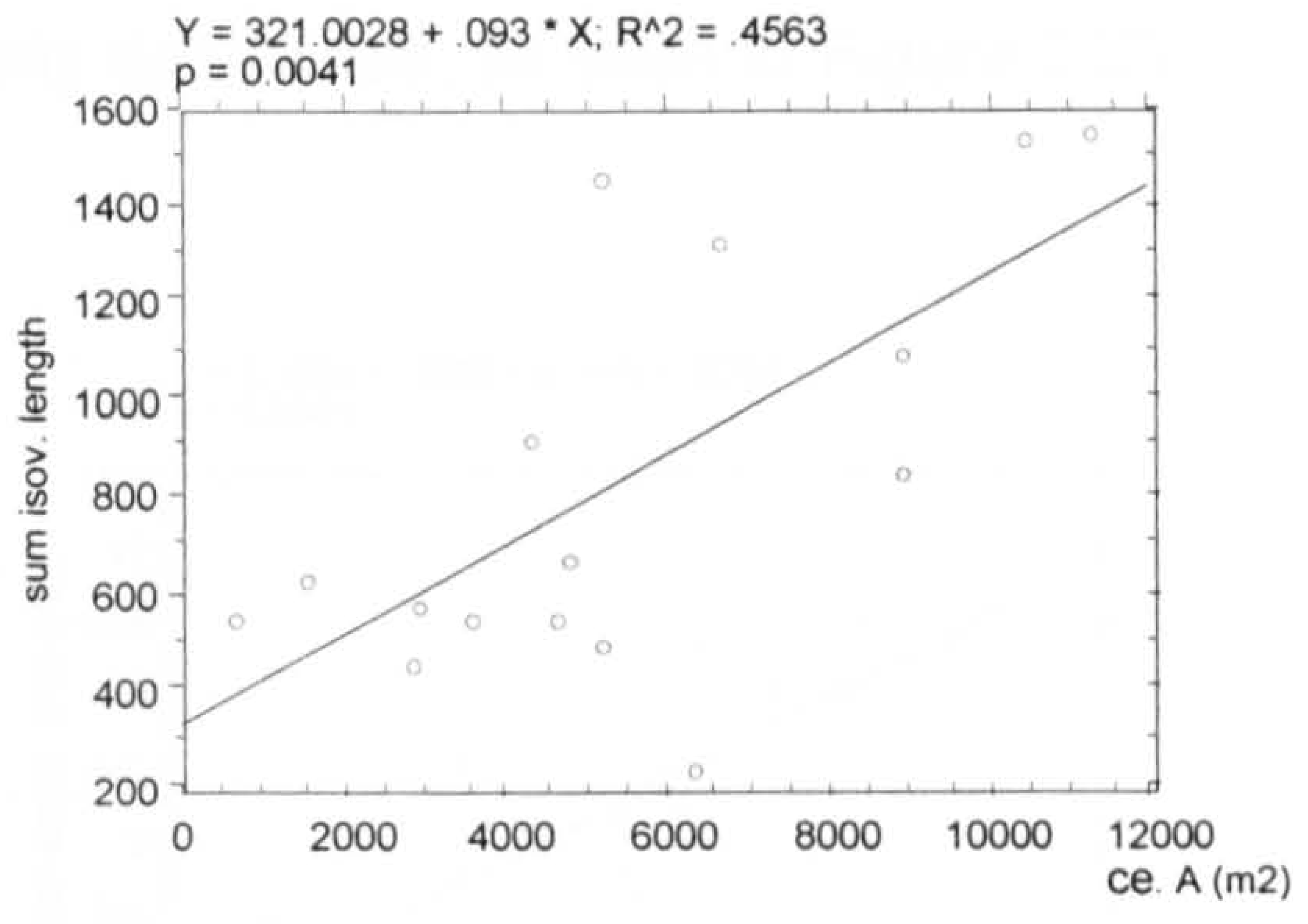

Figure 3.19. Scattergram main convex element area and the sum of isovist length n = 16

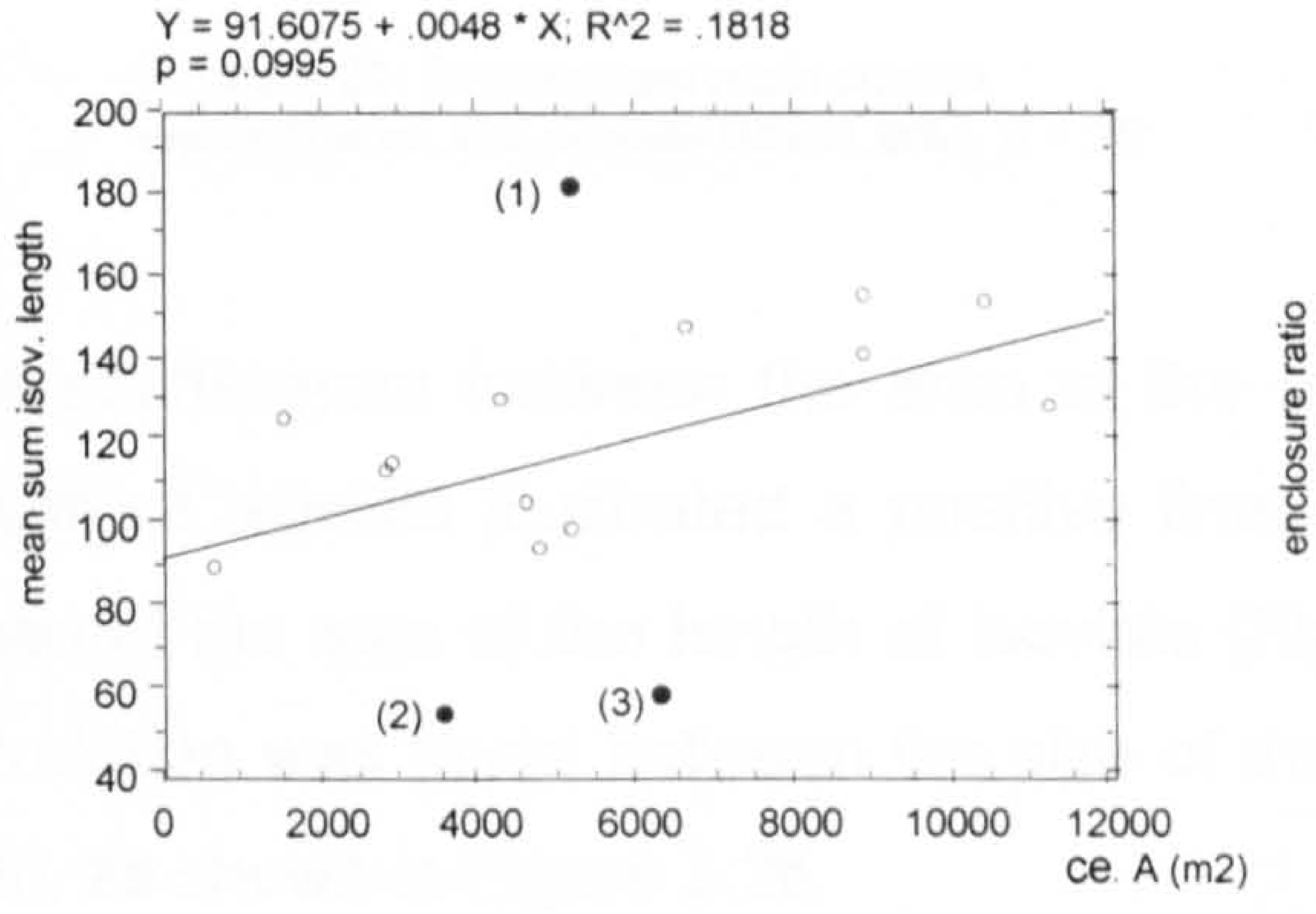

Figure 3.20. Scattergram main convex element area and mean of sum of isovist length, n = 16

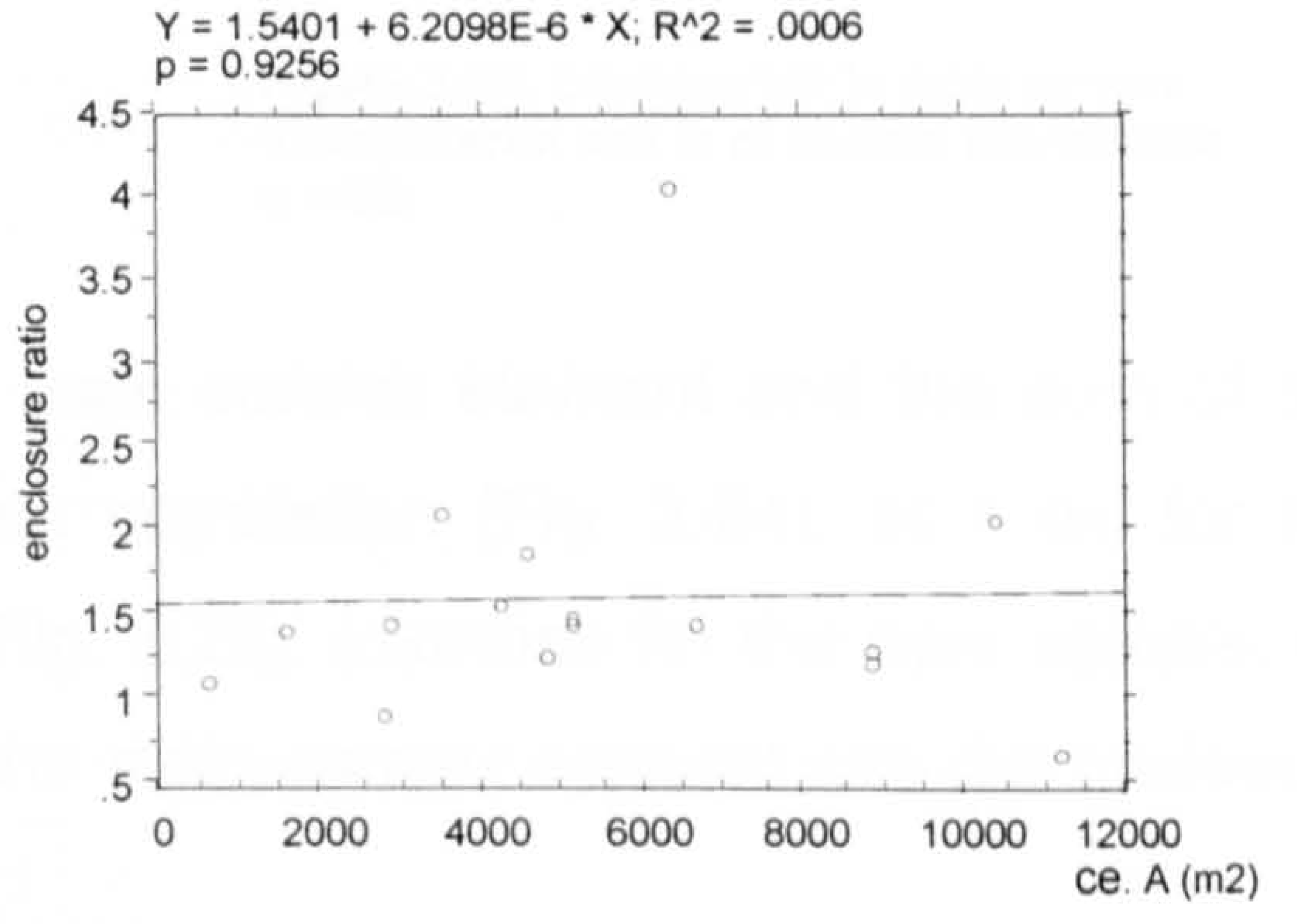

Figure 3.21. Scattergram main convex element area and enclosure ratio, n = 16

These properties are also found for the whole sample (all 30 cases). The results showed that there is a linear correlation between the main convex element and isovist areas, seen in Figure 3.22. However, a visual inspection of the scattergram suggests that for two cases where the area of the main convex element is well above the average for the sample may be giving rise to the correlation. It is therefore essential to assess whether these two urban squares with main convex element areas well above the rest of the sample are working as an artefact. The Kendal rank correlation test was applied. In the case of the convex isovist area, the results show that there is an association between the two variables[29]. In fact, if we were to omit these two examples to get an idea of the relationship between the two variables for the main convex elements with areas below 12000 m^2, the statistical analysis would show that both properties are maintained[30], with a good relationship. Nevertheless, it was

[29] The results are as follows: Tau corrected for ties = 0.5984, $p < 0.0001$.

[30] The results are: main convex element and isovist area: R-squared = 0.515 and p = 0.0001, n = 28.

necessary, by taking the logarithm (ln) of the main convex element area and isovist area, to transform both variables to be normally distributed, as seen in Figure 3.23.

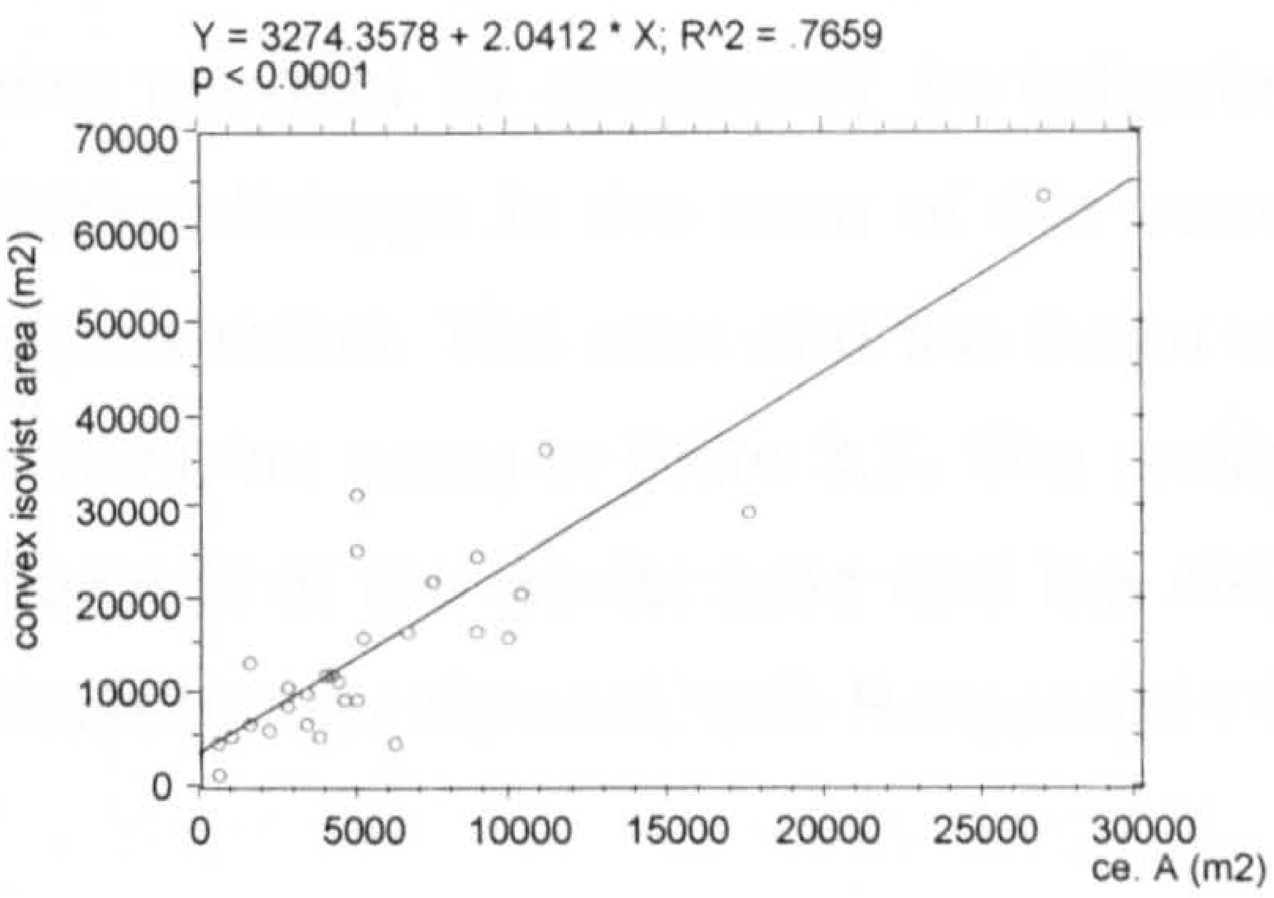

Figure 3.22. Scattergram main convex element area and convex isovist area, n = 30

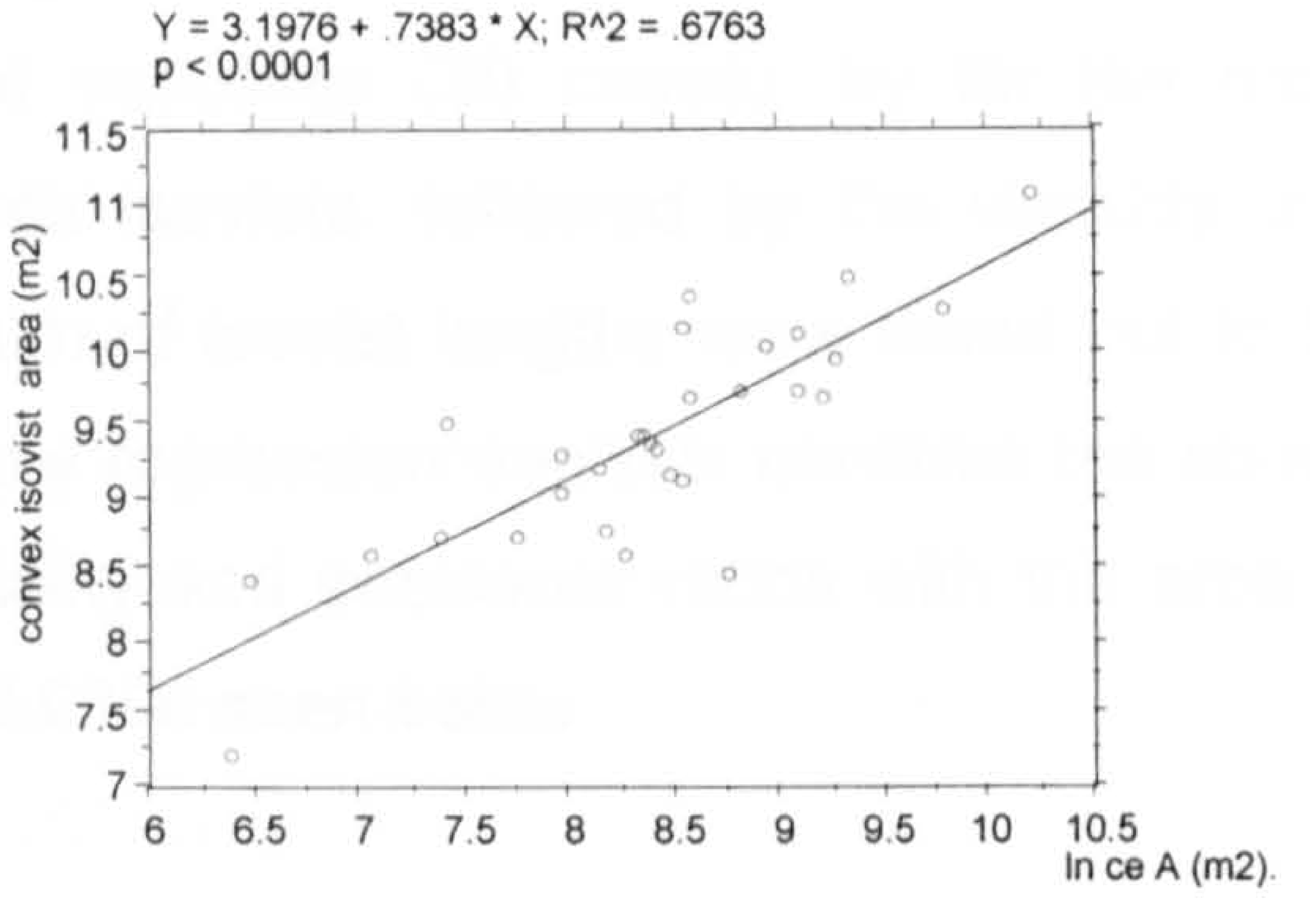

Figure 3.23. Scattergram ln main convex element area and ln of convex isovist area, n = 30

The scattergram between the area of the main convex element and the sum of the length of isovists illustrated a positive linear correlation (Fig. 3.24), as it did for the mean of the sum of the length of isovists (Fig. 3.25). Likewise for the core sample, no correlation was found between the size of the main convex element and the enclosure ratio, as shown in Figure 3.26.

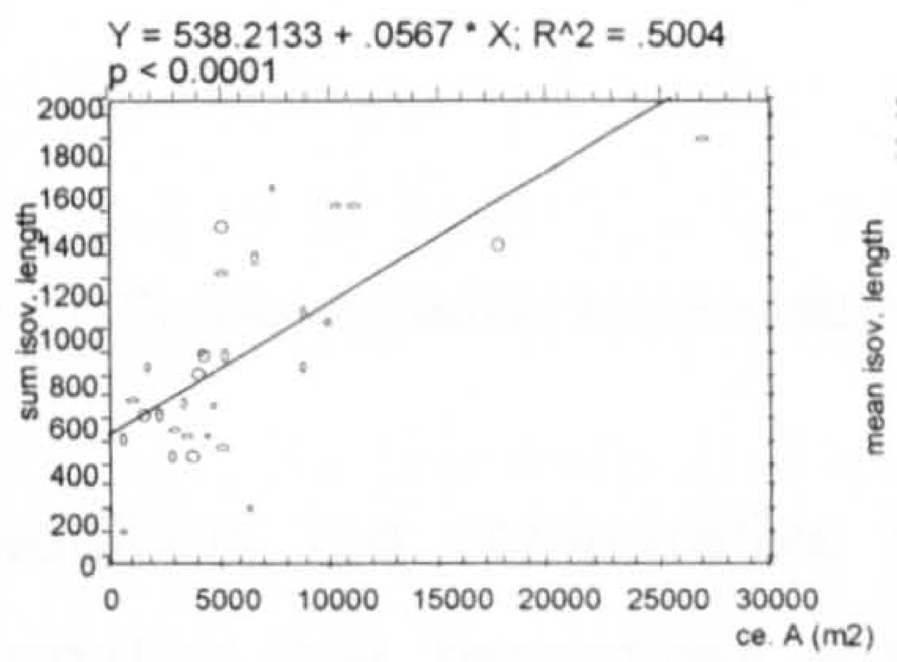

Figure 3.24. Scattergram main convex element area and sum of isovist length, n = 30

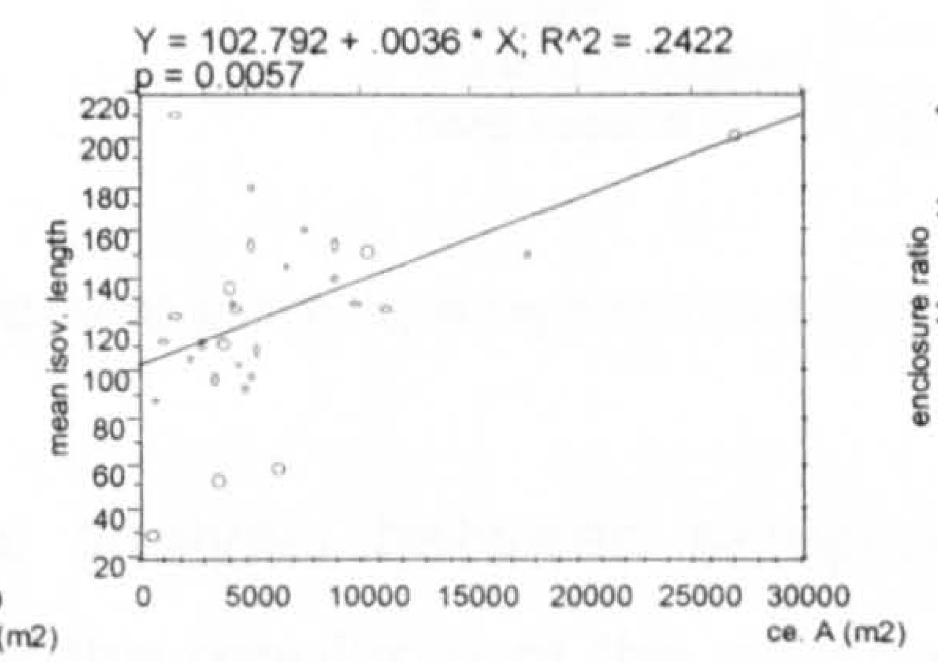

Figure 3.25. Scattergram main convex element area and mean of the sum of isovist length, n = 30

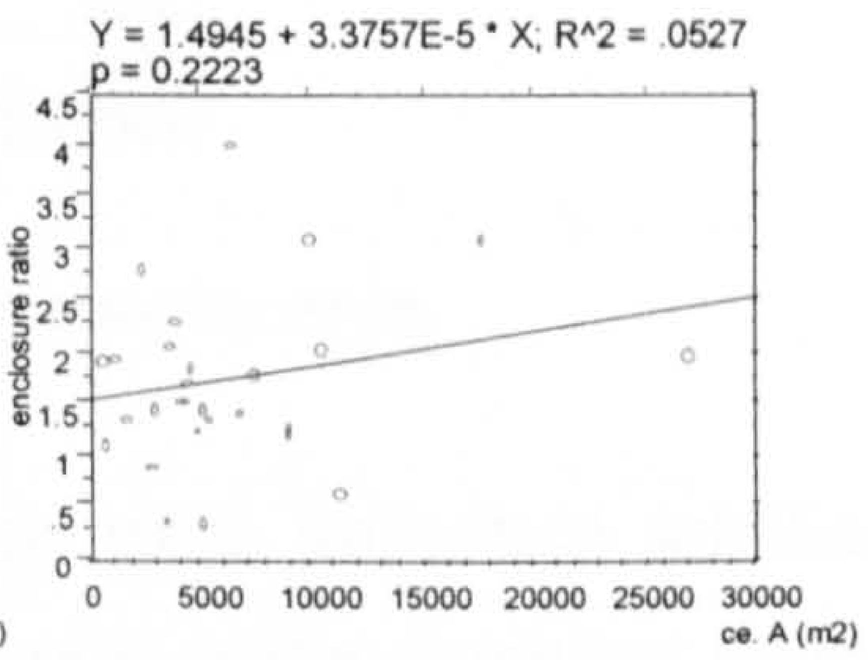

Figure 3.26. Scattergram main convex element area and enclosure ratio, n = 30

The analysis of the convex and isovist properties has showed that urban squares do indeed incorporate an "enclosure" property in the terms discussed. This tendency to enclose is a constant property that is largely independent of the size of the main convex element defining the urban square. However, there is a strong countervailing tendency for urban squares to create very powerful visual links with their surrounding urban environment, and this is a property which is affected by the size of the square: the larger the square, the more strongly "embedded" it is visually within its urban context. Notwithstanding their enclosed nature, traditional urban squares still retain powerful visual and access links between the urban space locally and the large scale grid structure of the town, and these linkages are indeed in proportion to the size of the public place. Using stepwise regression analysis, and comparing the area of the main convex element to previously investigated variables (30 cases), by far the most significant linkage is the area of the convex isovists, followed by the visibility and enclosure ratios. The sum and the mean sum of isovist lengths were found not to be significant, as seem in Plate 3.7. The multiple regression analysis confirms the strong relationship of the isovist area and the visibility and enclosure ratios with the area of the main convex element, with R-squared = 0.9306 seen below.

Stepwise regression summary

main convex element area vs. 5 independent variables

F-to-Enter	4.0000
F-to-Remove	3.9960
Number of Steps	3
Variables Entered	3
Variables Forced	0
Stepwise Procedure	Forward

Stepwise regression summary
Variables in model

main convex element area (m2) vs. 5 independent variables
step: 3

	Coefficient	Std. Error	Std. Coeff.	F-to-Remove
Intercept	536.9592	1223.1997	536.9592	.1927
isovist area	.3871	.0223	.9029	301.3325
visibility ratio	-909.6391	195.7256	-.2744	21.5995
enclosure ratio	1330.7799	403.8516	.1957	10.8585

Stepwise regression summary
Variables not in model

main convex element area vs. 11 independent variables
step: 3

	Partial Cor.	F-to-Enter
sum isov length (selc)	-.1179	.3526
mean isov length (selc)	.0793	.1581

Multiple regression analysis summary

main convex element area vs. 3 independent variables:
- convex isovist area
- visibility ratio
- enclosure ratio

Count	30
Num. Missing	0
R	.9647
R Squared	.9306
Adjusted R Squared	.9226
RMS Residual	1504.7806

Plate 3.7. Convex and isovist analysis: stepwise and multiple regression analysis summary results

In addition, the comparative analysis between samples gave important additional information that, regardless of the regularity of the urban grid or the dominant function of the urban square, the spatial characteristics hold good for both cases. This is a very interesting and important finding. By comparing squares in organic grids to geometric ones, or market and civic ones, the logic behind the spatial arrangement is suggested to be the same. Not only the size of the urban squares and isovists keep within a certain range but also the relationship between the size of the urban square, the isovists and the enclosure ratio is valid.

As far as convex and isovist spatial properties are concerned, it has been established with regard to both the core and whole sample that:

- Squares of traditional European towns are predominantly enclosed spatial elements as the built perimeter of the main convex element is greater than the unbuilt perimeter with a mean enclosure ratio of 1.70.
- The relationship between the urban squares and the visual links with the urban environment is larger than expected, being slightly more than three times their respective sizes (visibility ratio).
- The larger the main convex element, the larger the total size of its isovist.
- The larger the main convex element, the more extended into the surrounding urban fabric is the square's total linear visual field (sum of the length of the isovist).
- The mean length of the isovist is only very weakly associated with the size of the main convex element.
- The enclosure ratio of the main convex element is independent of its size.

3.4.2. INTERFACING AXIAL LINES ANALYSIS

This study examines the morphological properties of the axial lines that interface within the 30 urban squares. The way each square is embedded axially is fundamental to arriving at an understanding of its pattern of integration and in order to ascertain whether the proposed relation between the strategic value (Hillier, 1984), as described previously in Chapter 2, of a square and its size and importance within the urban grid really does exist. To the extent that such a relationship can be found, it may have implications for the pattern of local and global pedestrian movement in the squares and their surroundings. Though local in its scope, it is important to note that, at this stage, the analysis of the syntactic measures of the interfacing axial lines are derived from processing the axial break-up of the entire urban grid of each of the selected towns.

This section starts with the analysis of the axial lines defined by the urban fabric in the immediate vicinity of each square. This will be followed by an analysis of the correlations of the axial lines and the main convex element defining the urban square, in search of clues and consistencies in the access and visual links between the urban square and the environment. This section also investigates if there are preferred places for axial lines to intersect each other in the main convex element, referred to in this study as "intersection points". Insofar as axial lines can be related to patterns of pedestrian movement and also to the location of static people, the extent to which there is a tendency either for people to be directed to one specific area of the public square or for people to disperse to different areas of the same space, will be analysed. This might also give us some indications about preferred location and gradual occupation of public spaces by static people.

As discussed previously, the axial lines were classified according to the way they interface with the main convex element defining the urban square (C, T and P axial lines), as described in Section 3.3.3.2. Table 3.8 (presented in two consecutive pages) gives the data used for the analysis.

Towns	Sample	Sum axial lines length	Mean sum axial lines length	Sum of n° of (C) axial lines	Sum of n° of (T) axial lines	Sum of n° of (P) axial lines	Sum of n° of all axial lines
Bruges	core and whole	2526	315.75	6	1	1	8
Caernarvon	core and whole	618	206.00	1	•	2	3
Esslingen	core and whole	1004	200.80	3	1	1	5
Evora	core and whole	2396	266.22	9	•	•	9
Heilbronn	core and whole	1428	285.60	2	•	3	5
Kempten	core and whole	878	219.50	2	1	1	4
Kutna Hora	core and whole	1656	331.20	5	•	•	5
Magdeburg	core and whole	2537	281.89	6	•	3	9
Moguer	core and whole	1169	233.80	5	•	•	5
Nijmegen	core and whole	824	206.00	1	1	2	4
Palencia	core and whole	445	222.50	•	•	2	2
Pest	core and whole	2385	397.50	4	•	2	6
S. Gimignano	core and whole	943	117.88	7	•	1	8
Salisbury	core and whole	1334	333.50	2	•	2	4
Verdun	core and whole	2251	375.17	4	•	2	6
Volkermarkt	core and whole	1073	214.60	3	1	1	5
Borgomanero	whole	920	460.00	•	2	•	2
Brive	whole	731	146.20	4	1	•	5
Castellon	whole	1335	222.50	5	1	•	6
Groningen	whole	4490	561.25	5	2	1	8
Gyor	whole	2358	336.86	3	1	3	7
Kalisz	whole	1224	306.00	1	•	3	4
Klatovy	whole	1577	315.40	2	•	3	5
Litomerice	whole	2613	326.62	8	•	•	8
Modena	whole	1177	294.25	3	•	1	4
Montauban	whole	1514	216.29	6	•	1	7
Portalegre	whole	1045	209.00	4	1	•	5
Scarperia	whole	785	261.67	•	•	3	3
Wielun	whole	1161	290.25	1	•	3	4
Wolfsberg	whole	311	103.67	2	1	•	3

Table 3.8. Interfacing axial lines analysis data (1/2)

Towns	Sum R3 (C) axial lines	Sum R3 (T) axial lines	Sum R3 (P) axial lines	Local strat. value[31]	Sum Rn (C) axial line	Sum Rn (T) axial lines	Sum Rn (P) axial lines	Strategic value	Rn main line
Bruges	23.49	3.79	3.50	30.78	12.95	2.25	1.96	17.17	2.43
Caernarvon	2.02	•	6.40	8.42	1.48	•	4.57	6.05	2.68
Esslingen	8.60	2.66	3.69	14.95	4.10	1.26	1.49	6.85	1.50
Evora	33.62	•	•	33.62	16.68	•	•	16.68	2.13
Heilbronn	4.58	•	10.80	15.38	3.16	•	6.75	9.91	2.57
Kempten	4.51	2.24	3.03	9.78	2.63	1.39	1.54	5.57	1.54
Kutna Hora	18.86	•	•	18.86	9.63	•	•	9.63	2.01
Magdeburg	16.78	•	10.85	27.64	9.91	•	5.84	15.76	2.29
Moguer	16.47	•	•	16.47	8.32	•	•	8.32	1.78
Nijmegen	2.91	4.63	6.54	14.07	1.89	2.48	4.22	8.59	2.48
Palencia	•	•	4.22	4.22	•	•	2.64	2.64	1.35
Pest	12.49	•	7.61	20.10	7.84	•	4.32	12.16	2.81
S. Gimignano	18.98	•	4.04	23.03	12.83	•	2.73	15.56	2.73
Salisbury	4.96	•	6.91	11.87	3.57	•	6.50	10.07	3.45
Verdun	11.28	•	6.66	17.95	5.19	•	2.89	8.08	1.72
Volkermarkt	9.28	3.22	2.95	15.45	5.92	2.64	2.06	10.63	2.64
Borgomanero	•	6.82	•	6.82	•	5.55	•	5.55	3.47
Brive	10.81	3.51	•	14.32	7.01	1.89	•	8.90	2.33
Castellon	16.61	3.27	•	19.87	12.47	2.70	•	15.17	3.00
Groningen	19.51	10.11	4.35	33.96	12.92	6.57	2.66	22.14	3.50
Gyor	9.22	3.45	12.27	24.94	6.58	2.11	8.21	16.90	3.05
Kalisz	2.57	•	10.44	13.01	1.62	•	6.67	8.29	2.39
Klatovy	4.81	•	9.01	13.83	4.04	•	8.24	12.27	2.94
Litomerice	25.22	•	•	25.22	11.20	•	•	11.20	1.73
Modena	8.06	•	3.86	11.92	5.55	•	2.41	7.96	2.41
Montauban	17.75	•	3.21	20.95	11.91	•	2.25	14.16	2.25
Portalegre	12.14	3.00	•	15.15	5.30	1.22	•	6.52	1.44
Scarperia	•	•	8.88	8.88	•	•	7.83	7.83	3.92
Wielun	2.94	•	8.84	11.78	2.30	•	8.10	10.41	2.93
Wolfsberg	5.33	2.69	•	8.02	2.01	0.99	•	3.00	1.16

Table 3.8. Interfacing axial lines analysis data (2/2)

The core sample showed a total of 88 axial lines, where convergent axial lines represent the vast majority with 68.18% of all cases, followed by peripheric with 26.14% and transverse with just 5.68%. When analysing the average number of axial lines that interface with the main convex element, the core sample has an average of 5.5 axial lines per urban space. Convergent axial lines are present in 15 out 16 cases, followed by peripheric ones in 13 out of 16 cases, and transverse ones in only 5 out of 16 cases[32] (see Tables 3.9 and 3.10 in the page after next).

The whole sample keeps the same expression compared to the core, with a total number of 159 axial lines. Similarly, the average number of axial lines per main convex element is 5.3. Convergent axial lines represent the majority with 65.41% of the cases, followed by peripheric with 25.79% and transverse with 8.81%, showing a slight increase in the proportion of transverse axial lines compared to the core sample. The

[31] For definition of local and strategic values, refer to Section 3.3.3.2 and Table 3.1 in Appendix 1.

[32] For the remaining 14 cases (non-core sample), C axial lines represent the majority with 62% of the cases, followed by T lines with 13% and P lines with 25%. The mean number of axial lines per main convex element is 3.67 for C lines, 2.25 for P lines and 1.29 for T lines.

distribution of the different types of axial lines is also very uneven. There are only 3 public squares without "C" type lines, but 9 without "P" type lines and finally 18 that do not present any "T" type (see Table 3.8).

An analysis of the different types of axial lines in respect to the regularity of the urban grid did not show a predominance of any kind. Squares in geometric grids do not have more transverse axial lines that the ones in organic grids and the same is valid for the other permutations.

This gives us an initial picture of the majority of axial lines that interface with the traditional public squares tending to terminate inside the urban square. The lines that cross public squares and continue are quite rare. This seems to confirm a point suggested by Sitte and others: from the entry point where someone might be standing, one does not get a direct extended view of another interfacing street across the urban square.

Finally, analysis of the length of the axial lines showed an interesting variation. Convergent axial lines tend to be the shortest ones (247.96 m) and transverse axial lines the longest ones (356.00 m), as seen in Table 3.9, next. Convergent axial lines comprise the majority in organic types of urban grid. Due to the morphological characteristics of the urban grid, these lines also tend to be shorter (metrically speaking) compared to transverse axial lines which, we might say, are more characteristic of geometric grid types and which are therefore also longer. This may raise some questions concerning the size of the catchment area of public squares in traditional towns, and of how local or global they are. On the other hand, although long axial lines tend to be more globally integrated due to their likely higher number of connections, short axial lines depending on the configuration of a particular grid can easily be highly integrated too. Plate 3.6 (refer to Section 3.3.3.3.), which shows the global integration values of the axial break up of the 30 selected towns for this study, illustrates this point. The highest global integrated axial line of Moguer (Figure 9, Plate 3.6) is one of the shortest lines of the system. So, if we can establish that there is a correlation between axial lines and the number of static and moving people inside public spaces, it will be interesting to see if the correlation is a matter of syntactic, metric or both properties. Tables 3.9 and 3.10 give a summary of the quantitative data generated by the analysis, with the results being presented first for the core sample and later for the whole sample.

Element	Total nº. C axial line	Percentage of distribution	Total nº. T axial lines	Percentage of distribution	Total nº. P axial lines	Percentage of distribution	Total nº. axial lines
Core sample	60	68.18	05	5.68	23	26.14	88
Whole sample	104	65.40	14	8.81	41	25.79	159
Church	6	75.00	2	25.00	0	•	8
Main	64	69.57	7	7.61	21	22.82	92
Market	20	51.28	3	7.69	16	41.03	39
Civic	14	70.00	2	10.00	4	20.00	20
Organic	59	73.75	5	6.25	16	20.00	80
Semi-regular	32	68.08	6	12.77	9	19.15	47
Geometric	13	40.62	3	9.38	16	50.00	32
Length axial line whole sample	247.96 m	•	356.00 m	•	348.48 m	•	281.18 m

Table 3.9. Frequency distribution of axial lines according to type

Element	Nº. cases	Mean nº. axial lines (C)	Mean nº. axial lines (T)	Mean nº. axial lines (P)	All axial lines
Core sample	16	4.000	1.000	1.769	5.500
Whole sample	30	3.852	1.167	1.952	5.300
Church	2	3.000	1.000	0	4.000
Main	17	4.571	1.400	1.750	5.412
Market	7	2.857	1.000	2.286	5.571
Civic	4	3.500	1.000	2.000	5.000
Organic	14	4.538	1.000	1.600	5.714
Semi-regular	9	3.556	1.200	1.800	5.222
Geometric	7	2.600	1.500	2.667	4.571

Table 3.10. Average number of axial lines per main convex element according to type[33]

Summarising, the spatial analysis has shown that there is a gathering of axial lines into urban squares. However, the axial lines show some distinctive properties. There is a high incidence of axial lines that stop within the main body of the urban space as opposed to the number of axial lines that go through, a phenomenon previously discussed by Hillier and Hanson (1984). "Urban market places in European countries, for example, wherever they are geometrically in the settlement, are nearly always axially shallow from the outside, and have the curious, though intelligible property that the axial lines in their vicinity are strong and lead to the square but never through it. Strangers are speeded on their way into the square, but once there are slowed down" (Hillier and Hanson, op.cit., p17). Assuming that the different types of axial lines can be associated to different types of pedestrian movement, if the line has to go across the urban square, it will do so without interfering much with the dynamics of the space and generally will be located in the periphery, leaving the axial lines that go across the space as the ones that will terminate within the urban square itself.

The analysis moves on to investigate the relationship between axial lines and the size of urban squares, specifically regarding their number, length and strategic value.

33 The mean number of axial lines according to categories was calculated by dividing the number of axial lines from a category by the number of public squares that have this type of axial line interfacing with the public square.

For the core sample, the analysis of the scattergram for the area of the main convex element against the sum of the number of axial lines did show a linear correlation, as seen in Figure 3.27. The analysis was then broken down according to the categories of axial lines, that is, convergent, transverse or peripheric. Upon analysis of the results, the major problem that we encounter is the lack of a reasonable number of different types of axial lines in all cases. For instance, only one transverse axial line is present in five cases in the sample. The results are illustrated in Figures 3.28, 3.29 and 3.30 respectively, and no correlation was found between the two variables in all three cases.

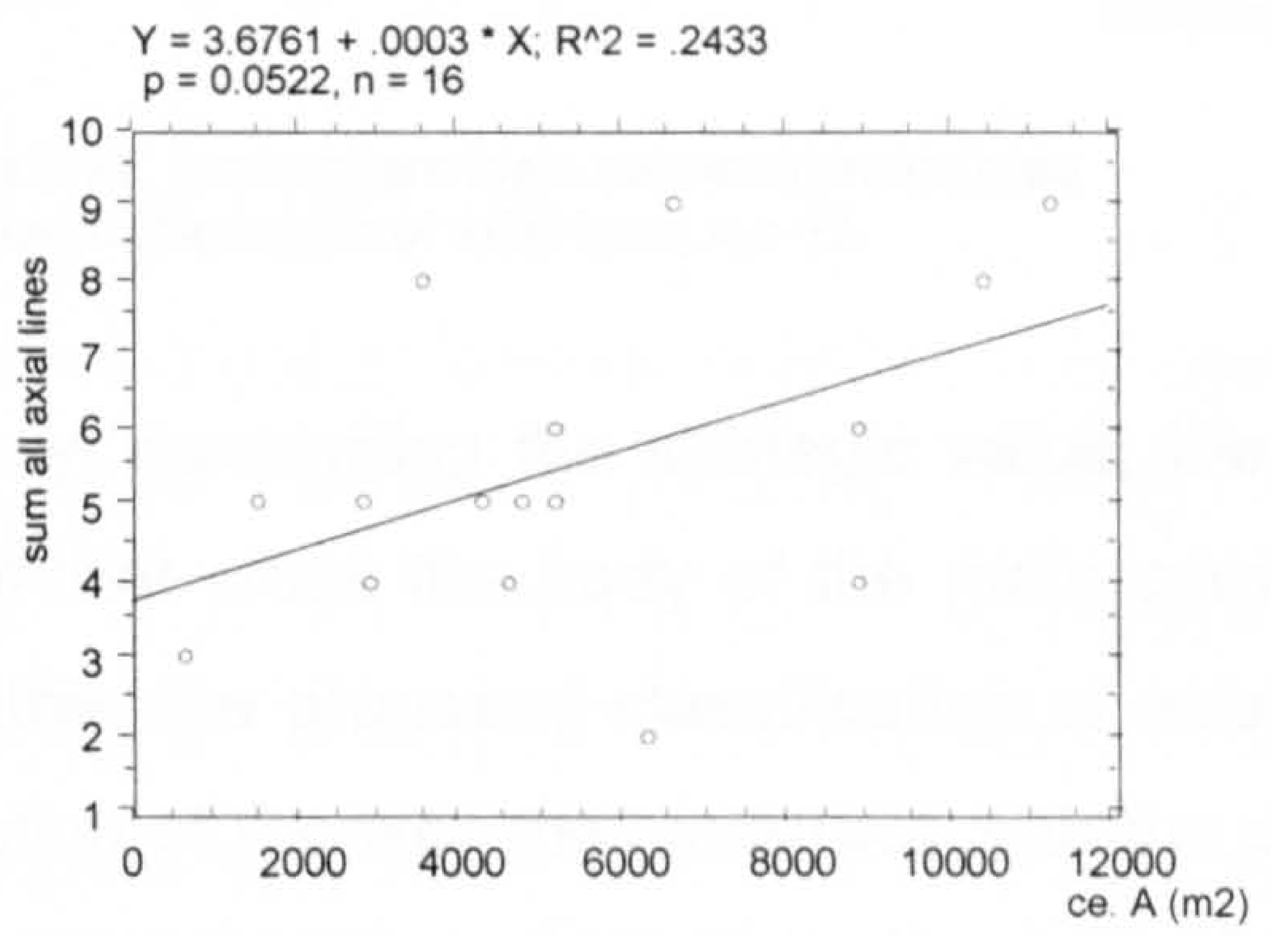

Figure 3.27. Scattergram main convex element area and sum of number of axial lines, n = 16

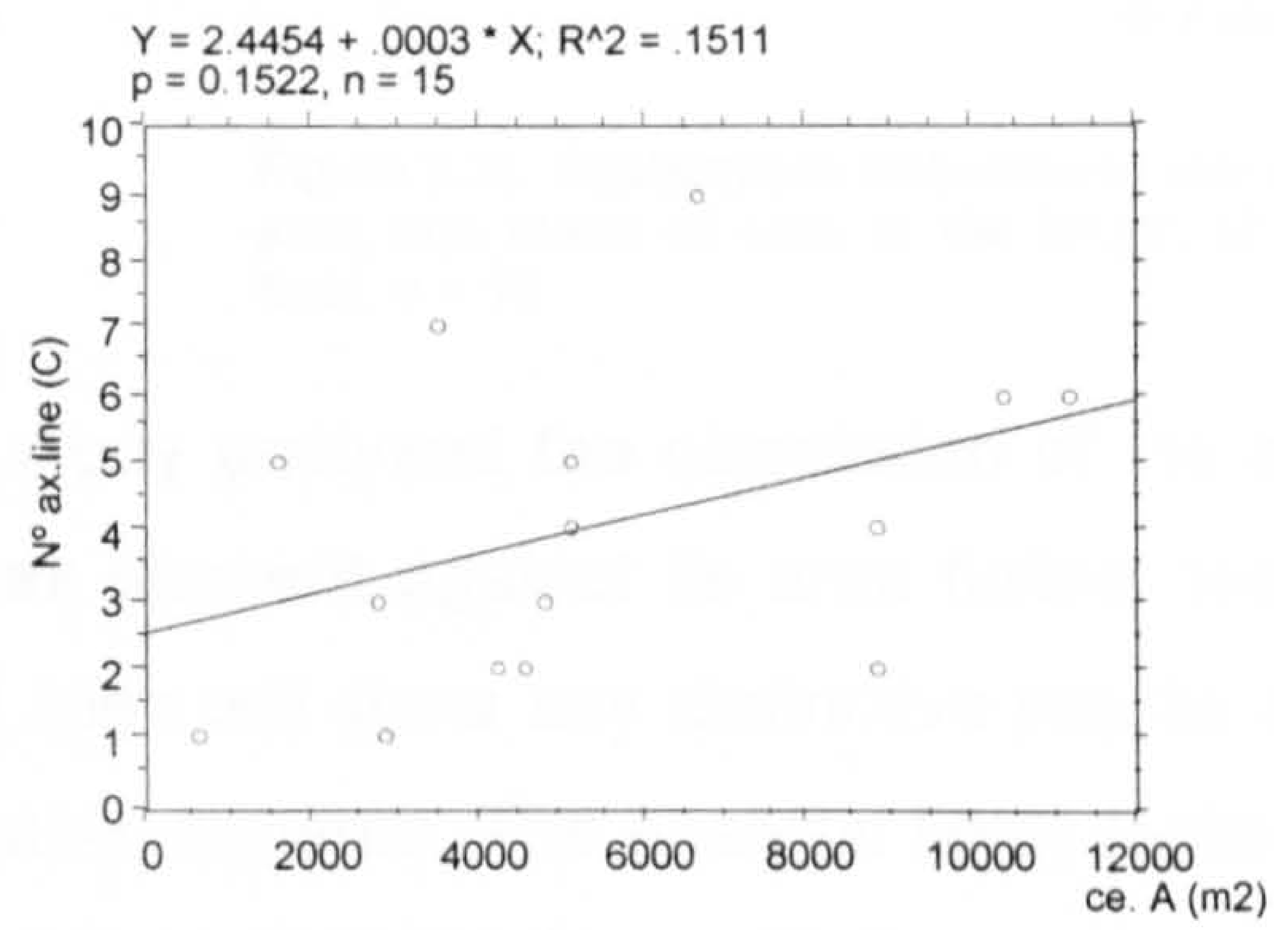

Figure 3.28. Scattergram main convex element area and sum of number of C axial lines, n = 15

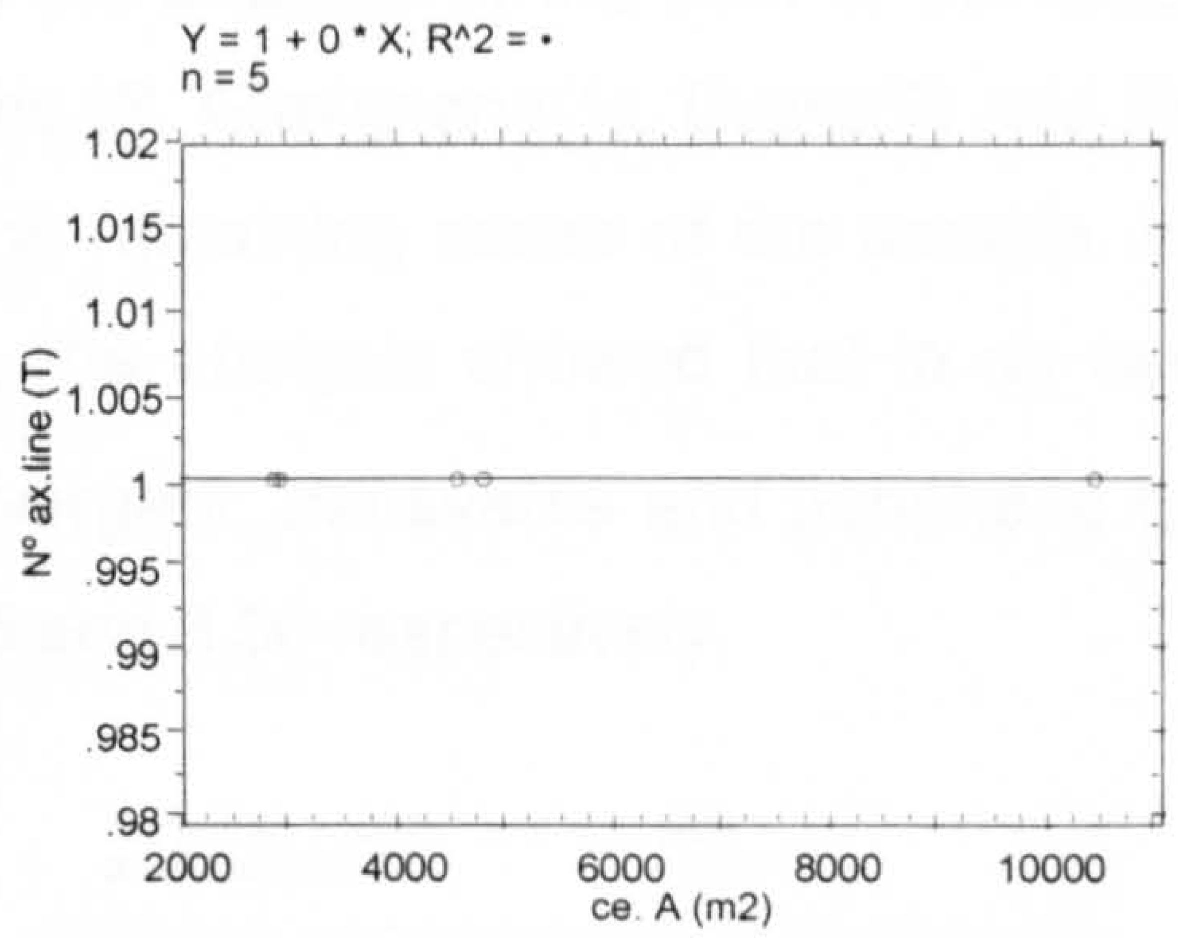

Figure 3.29. Scattergram main convex element area and sum of number of T axial lines, n = 5

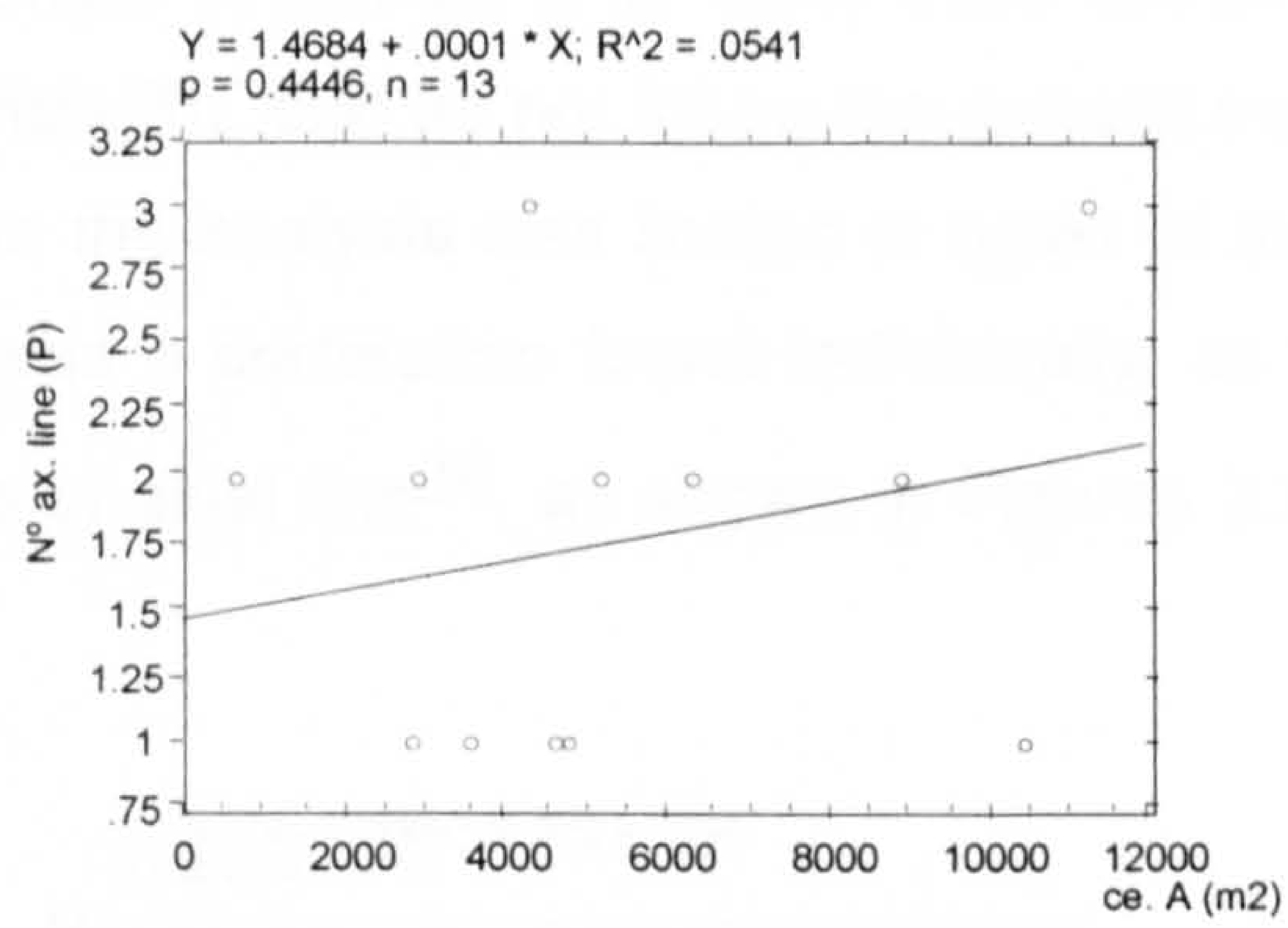

Figure 3.30. Scattergram main convex element area and sum of number of P axial lines, n = 13

Regarding the length of the axial lines, the scattergram for the sum of the length of the axial lines showed a liner correlation, and no distinction was made according to the proposed classification due to the low incidence of cases as discussed before. This mirrors the findings for the earlier isovist analysis. It is recalled that when the area of the main convex elements for the core sample was correlated with the sum of the length of isovists, a linear correlation was found (see Fig. 3.19). The same can be said of the mean length of the axial lines, for which the positive results are also consistent for the mean isovist length (see Fig. 3.20). Figures 3.31 and 3.32 illustrate the findings.

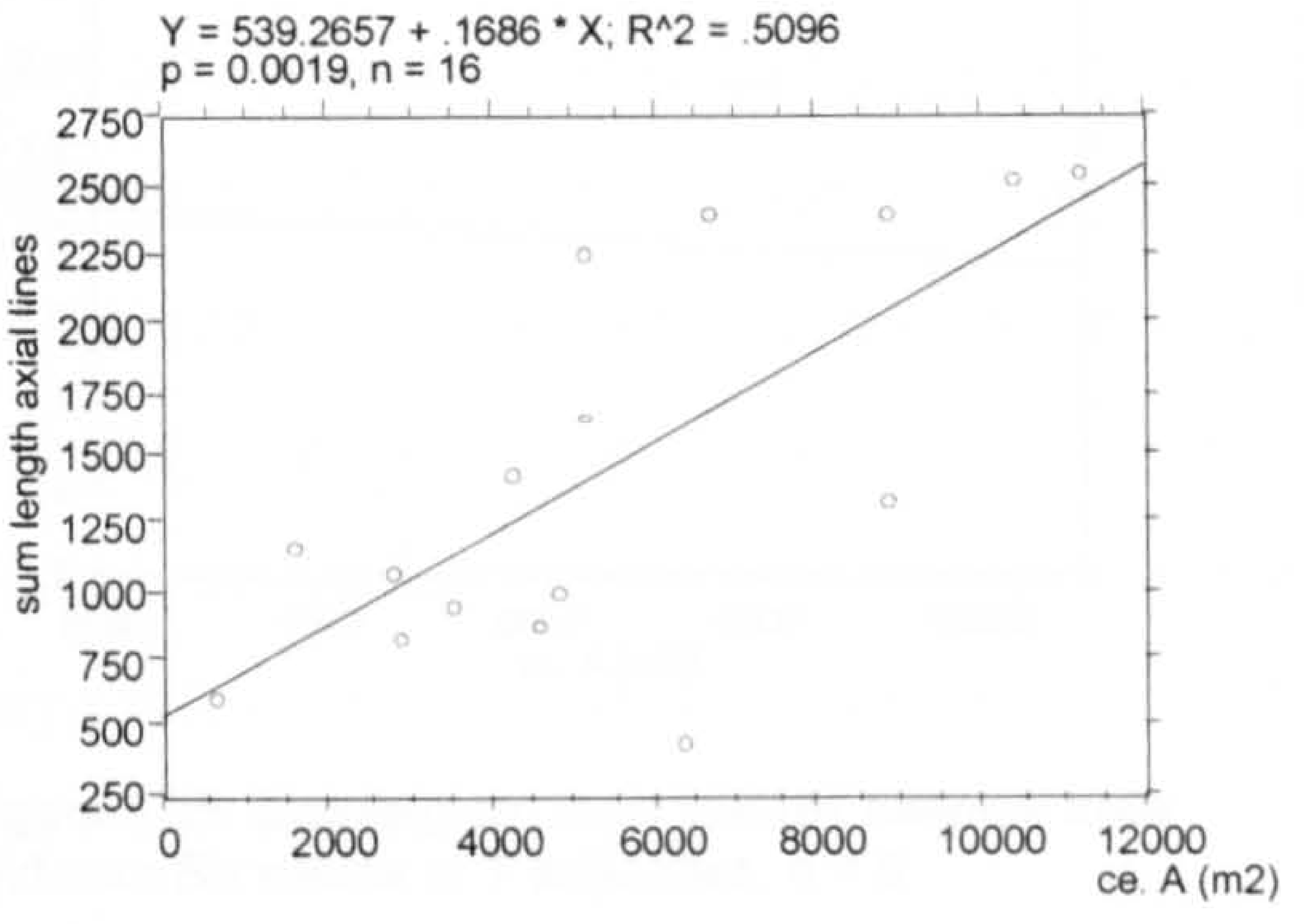

Figure 3.31. Scattergram main convex element area and sum of the length of axial lines, n = 16

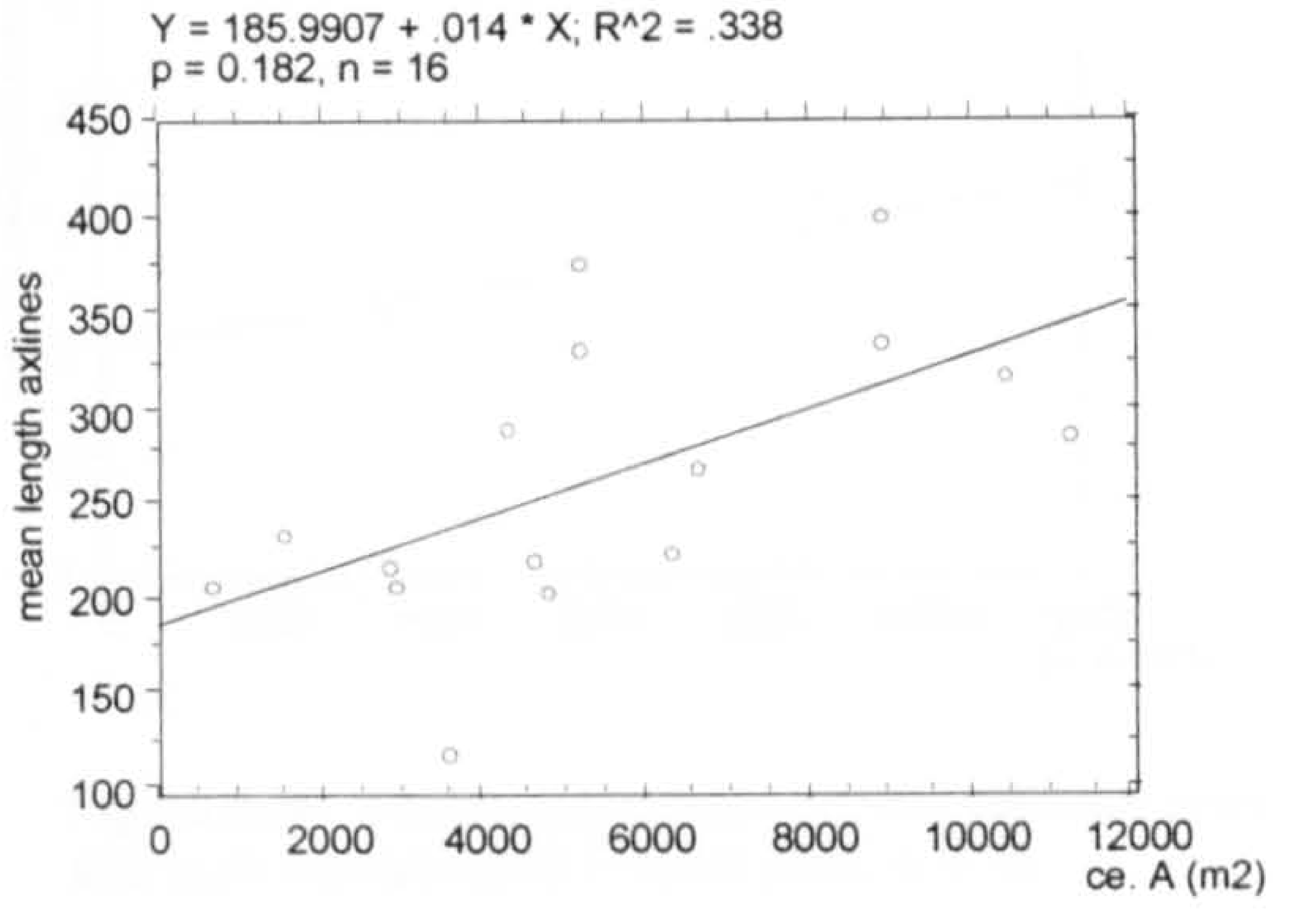

Figure 3.32. Scattergram main convex element area and mean of sum of the length of axial lines, n = 16

Finally, concerning the strategic value, the study analysed the correlation of the axial lines that cross the body of the main convex element against its area further testing whether the proposed classification of axial lines will show any distinctive results as a function of the way they interface with the public squares. The analysis firstly looked at the strategic value, defined by the sum of all lines that interface with the main convex element. The scattergram showed a weak linear correlation, as shown in Figure 3.33. Like the analysis of the sum of the mean length of isovists (Fig. 3.20) there are three cases (S. Gimignano(1), Evora(2) and Palencia(3)), that do not follow the general trend of the remaining cases of the sample. When the analysis was limited to types of axial line, the analysis showed that in no case was a correlation found individually, as for convergent, transverse and peripheric types of axial line[34], as shown in Figures 3.34, 3.35 and 3.36 respectively.

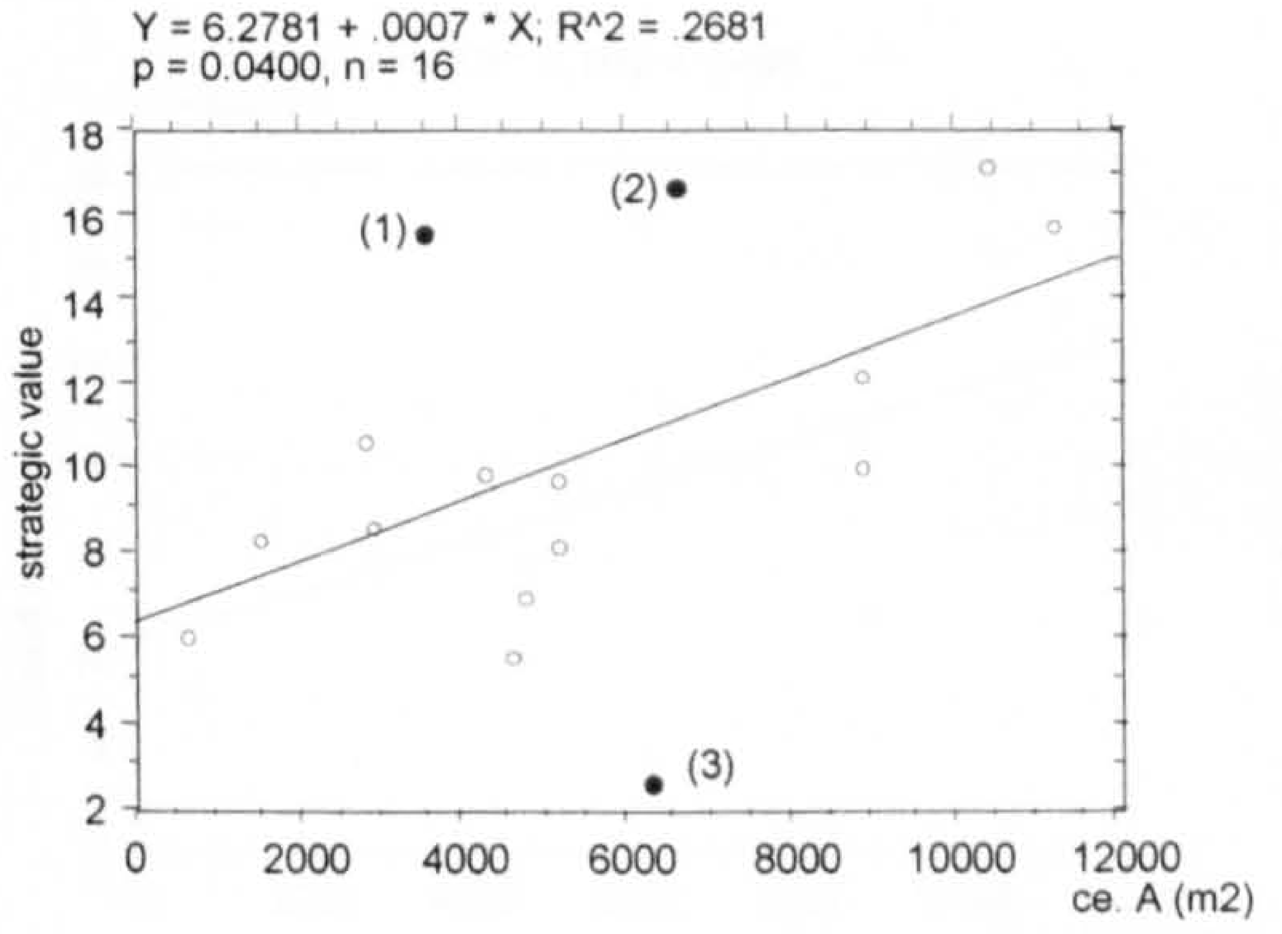

Figure 3.33. Scattergram main convex element area and strategic value, n = 16

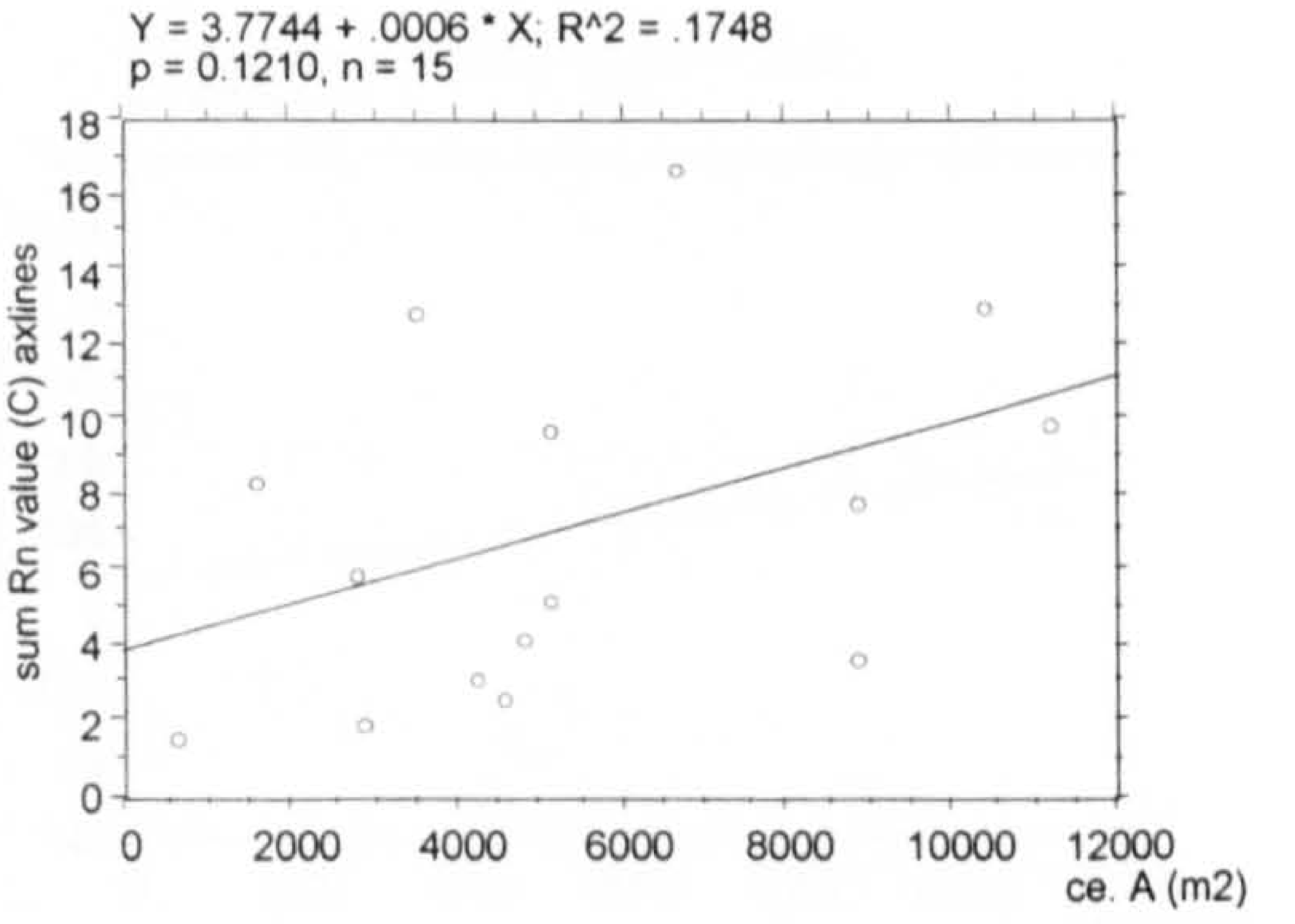

Figure 3.34. Scattergram main convex element area and sum Rn values of C axial lines, n = 15

34 Note that convergent, transverse and peripheric axial lines are not present in all urban squares. Refer to general data Table 3.2 in Appendix 1.

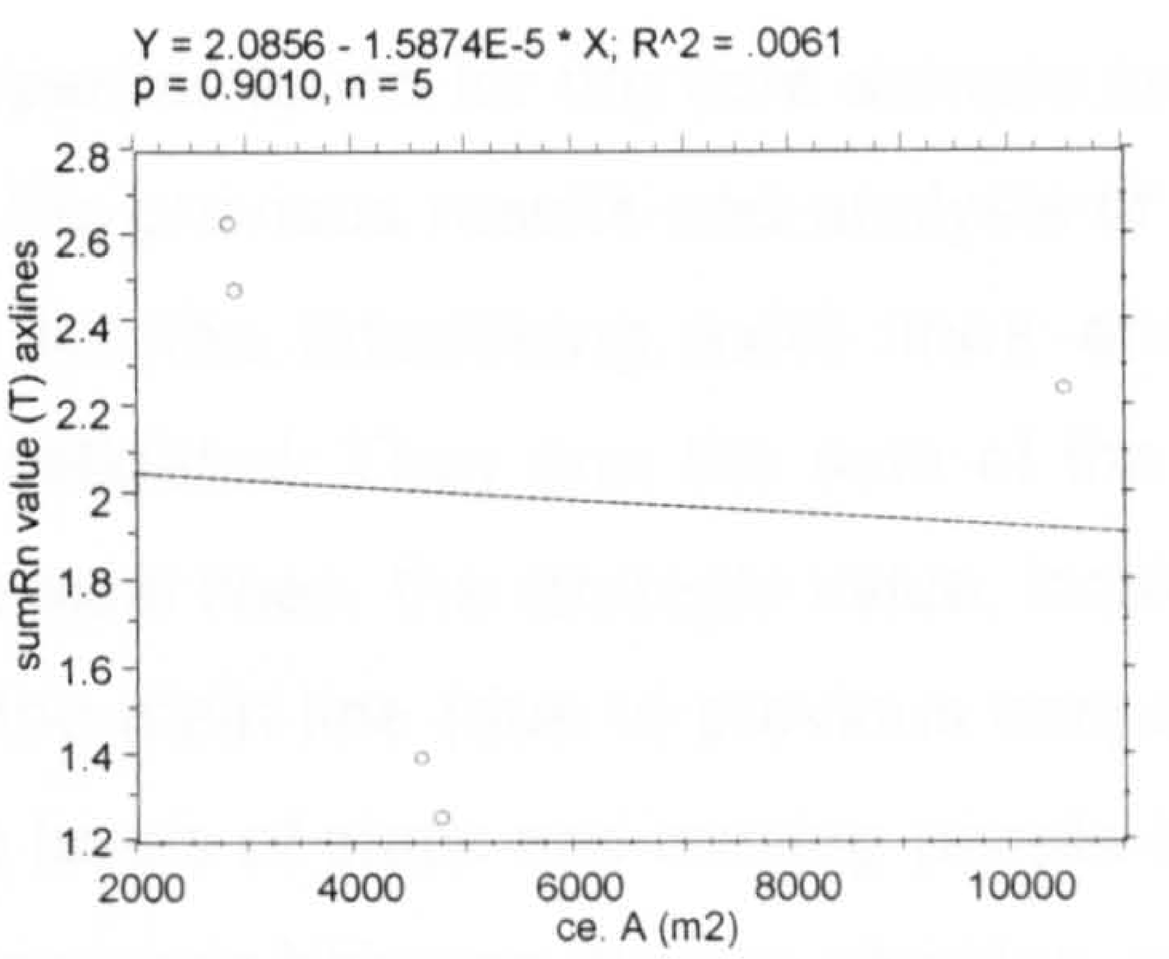

Figure 3.35. Scattergram main convex element area and sum Rn values of T axial lines, n = 5

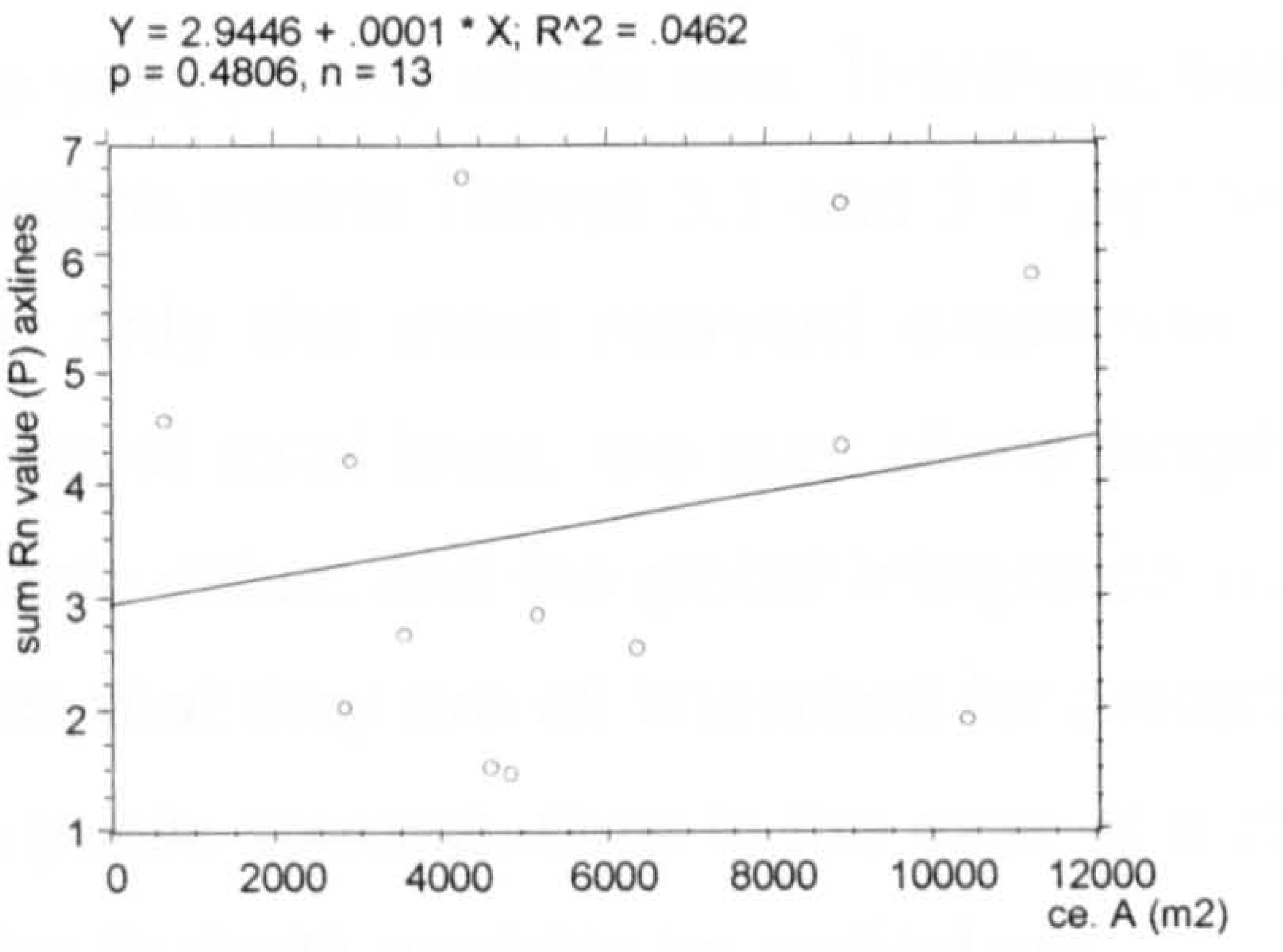

Figure 3.36. Scattergram main convex element area and sum Rn values of P axial lines, n = 13

The results were subsequently examined to see if the local strategic value (refer to Section 3.3.3.2) of the main convex element would correlate with its area. It is suggested that urban squares, although they are important spatial elements in the global structure of the urban environment, are undoubtedly strategic elements at a local level. In addition, the correlation matrix (Table 3.3, Appendix 1) gives some indication that, like the strategic value, the local strategic value might be associated with the size of the main convex element. However, like the strategic value, only a very weak linear correlation was found for the local strategic value (Fig. 3.37).

In addition, the correlation of the area of the main convex element and the integration value of just the main axial line[35] that crosses the urban space was examined, because of the suggested relevance of the axial line in relation to the numbers of people moving through the public space. The scattergram shows no linear correlation, as seen Figure 3.38.

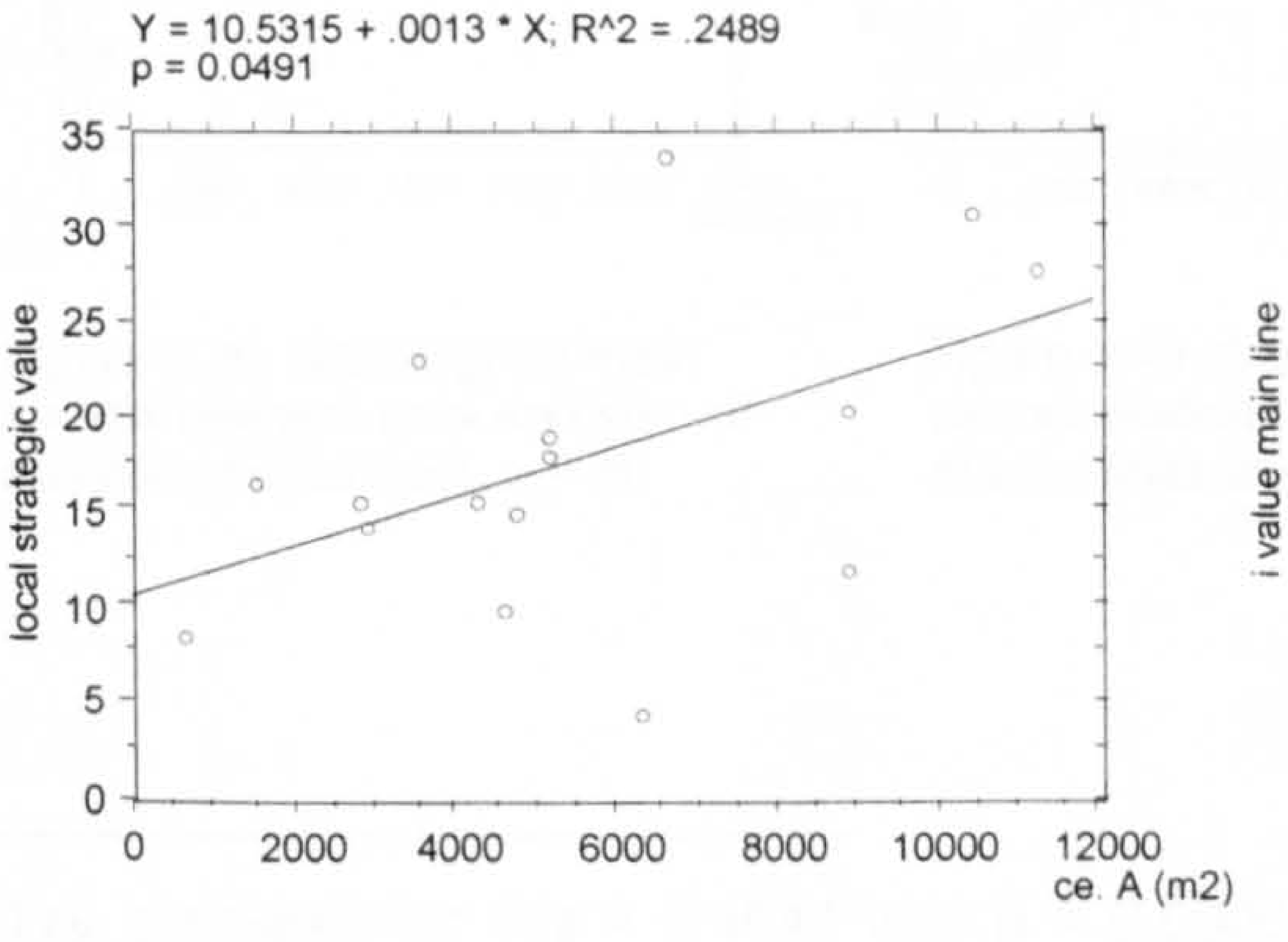

Figure 3.37. Scattergram main convex element area and local strategic value, n = 16

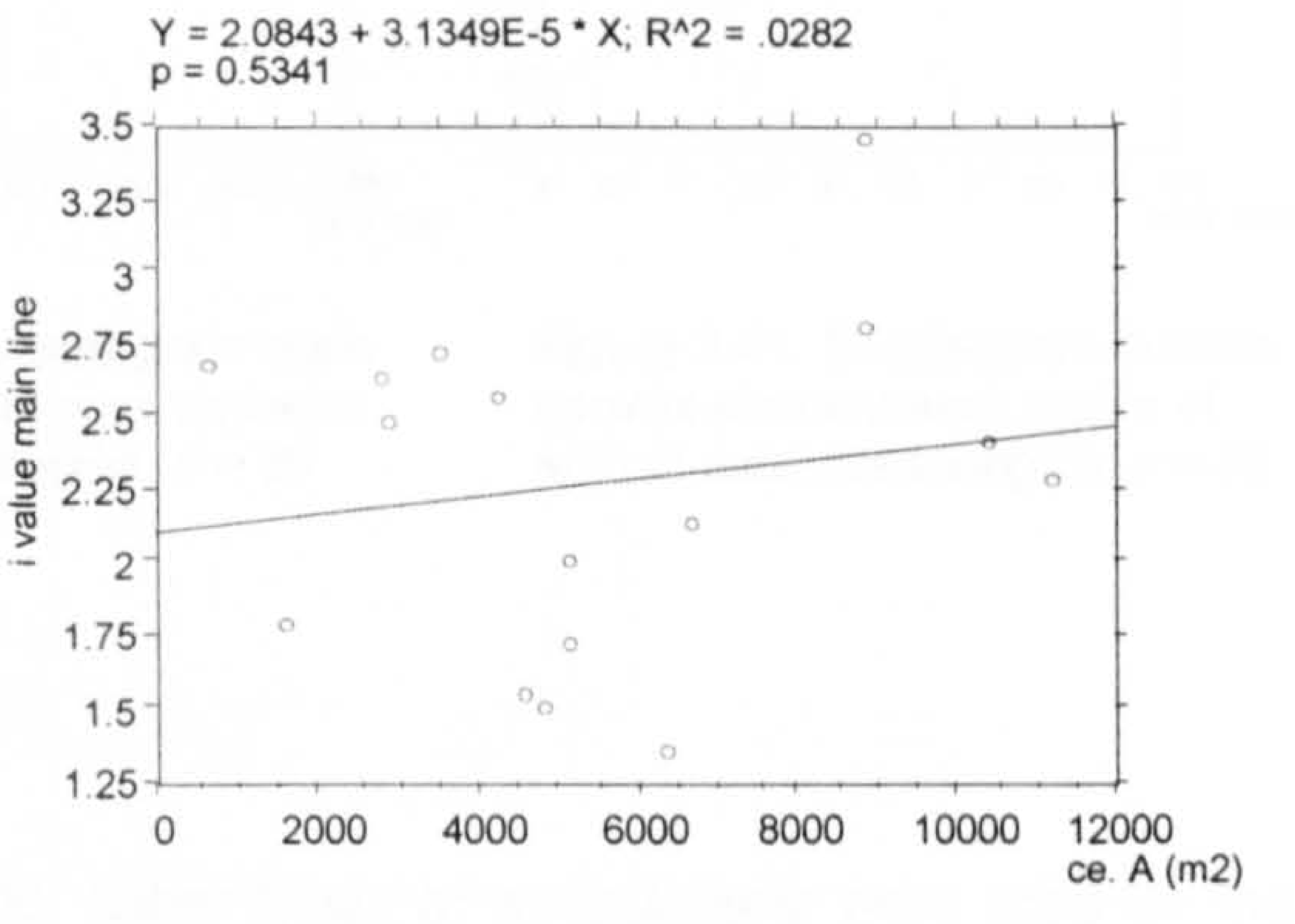

Figure 3.38. Scattergram main convex element area and Rn value of main axial line, n = 16

35 The "Main line" is defined by the line with the highest global integration value (Hillier, 1984).

The previous convex and isovist analysis has already showed that the general properties found for the core sample are also valid for the whole one. Therefore, based on the previous results and analysis of correlation matrix Tables 3.3 and 3.4 (Appendix 1), for the interfacing axial lines analysis, only the most relevant properties are investigated. They are: the sum of the number of axial lines, the sum of the length of the axial lines, the strategic value, local strategic value, and the global integration value of the main line (due to previous conjunctures that they are all important for predicting the levels of static and moving people inside public spaces). Only in the case of a clear divergence between the two samples, will more in-depth analysis be carried out.

The analysis of the above mentioned properties showed the same results for the whole sample in all cases. The scattergram (Fig. 3.39) for the area of the main convex element against the total number of axial lines showed a linear correlation[36], as did for the sum of the length of the axial line (Fig. 3.40). The visual analysis of the scattergram itself suggests that the two top right dots representing the main convex elements of the urban squares in Groningen and Litomerice could be giving rise to the positive results of the correlation analysis. The non-parametric test[37] confirmed the positive relationship between the two variables. However, as carried out for the isovist area analysis (Fig. 3.23), the logarithm of area of the main convex element and sum of the length of the axial lines was calculated to have both variables normally distributed, as seen in Figure 3.41.

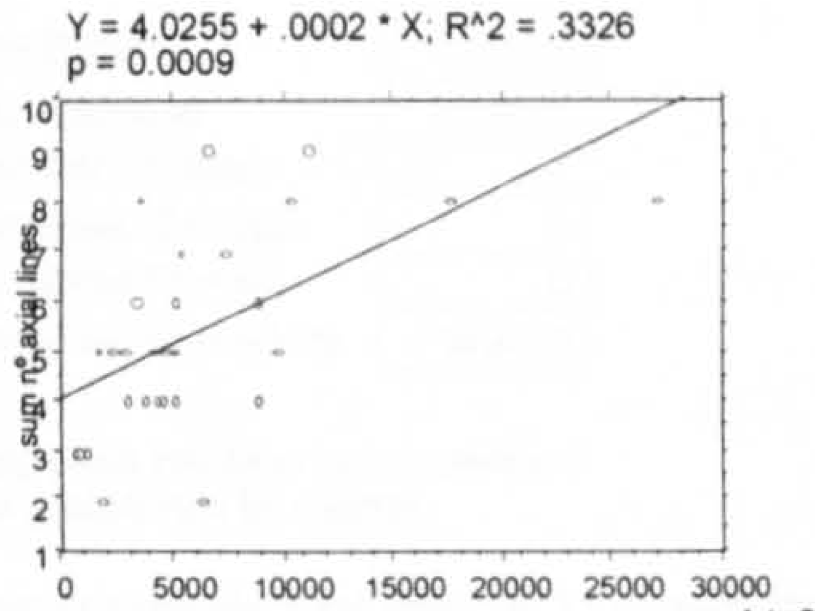

Figure 3.39. Scattergram main convex element area and sum of number of axial lines, n = 30

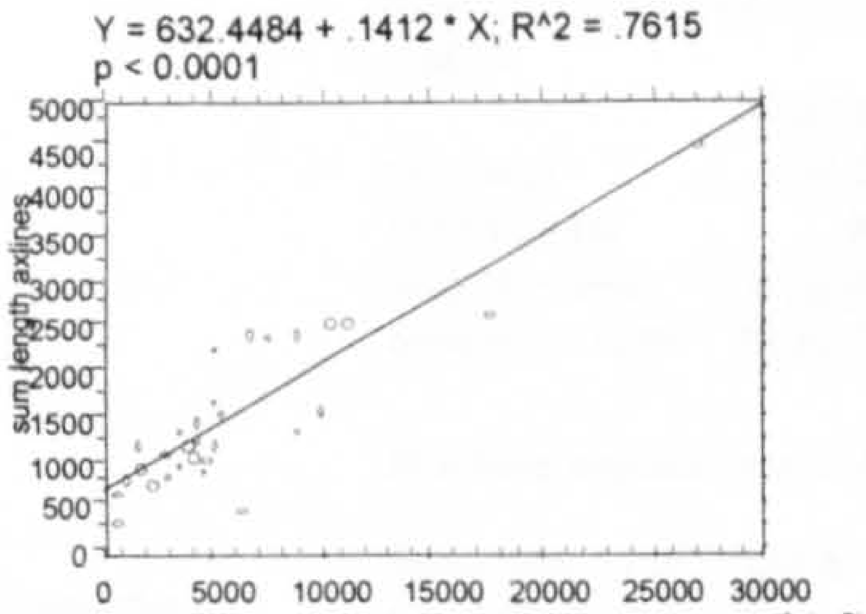

Figure 3.40. Scattergram main convex element area and sum of axial lines lengths, n = 30

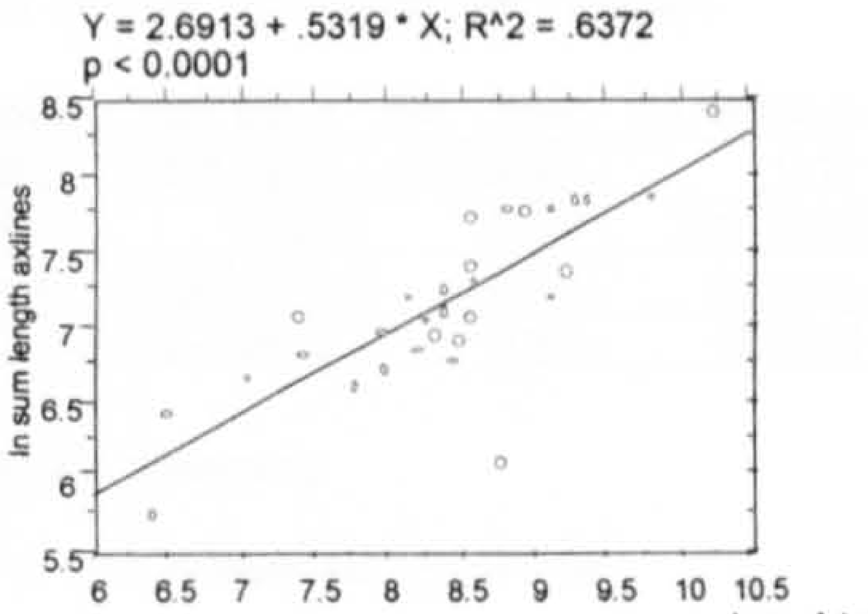

Figure 3.41. Scattergram ln main convex element area and ln of sum of axial lines lengths, n = 30

[36] Tau corrected for ties = 0.4648 with p = 0.0003. Other types of associations were tried for the two variables, such as exponential, and linear is the one that best fits the data, despite the weak results.

[37] The results of a Kendal rank correlation are: Tau corrected for ties = 0.6628 with $p < 0.0001$. In fact, if the two points corresponding to Groningen and Litomerice are excluded, a linear positive correlation can still be found with $R^2 = 0.5757$ and $p < 0.0001$.

Regarding the strategic value, the data showed a linear correlation with the area of the main convex element (Fig. 3.42), as did for the local strategic value (Fig. 3.43). Finally, the analysis between the Rn main line and the area of the main convex element, as for the core sample, did not show a linear correlation as illustrated in the scattergram in Figure 3.44 next.

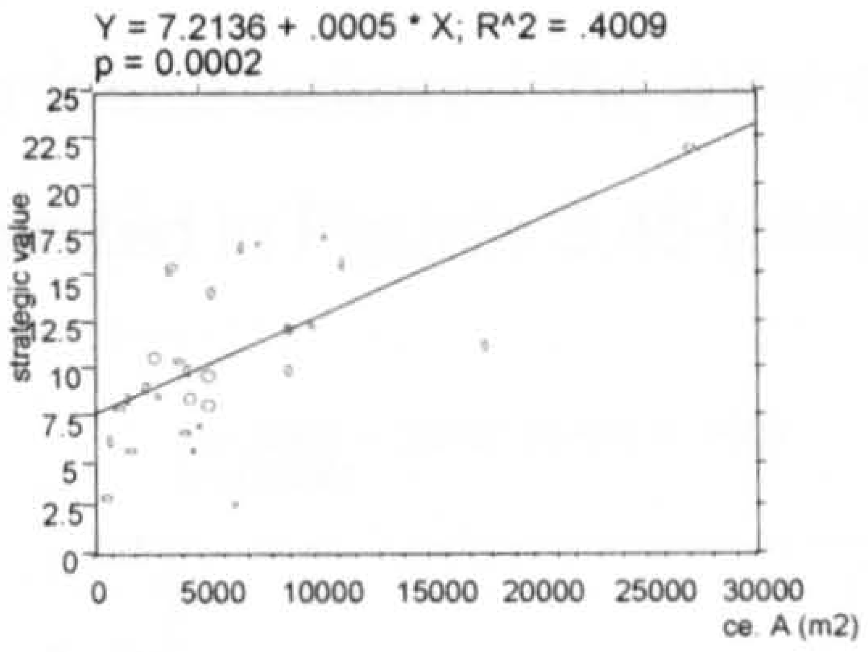

Figure 3.42. Scattergram main convex element area and strategic value, n = 30

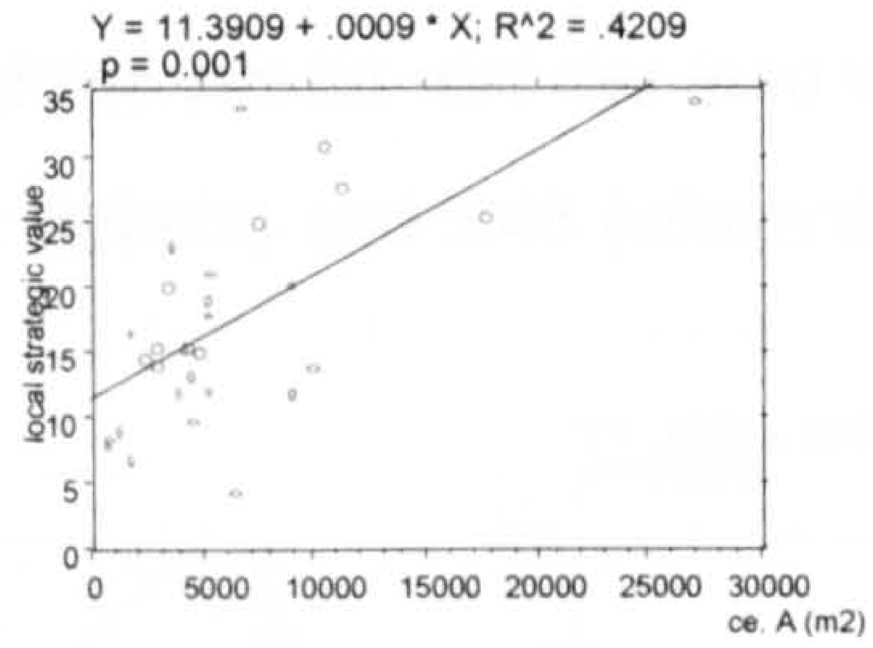

Figure 3.43. Scattergram main convex element area and local strategic value, n = 30

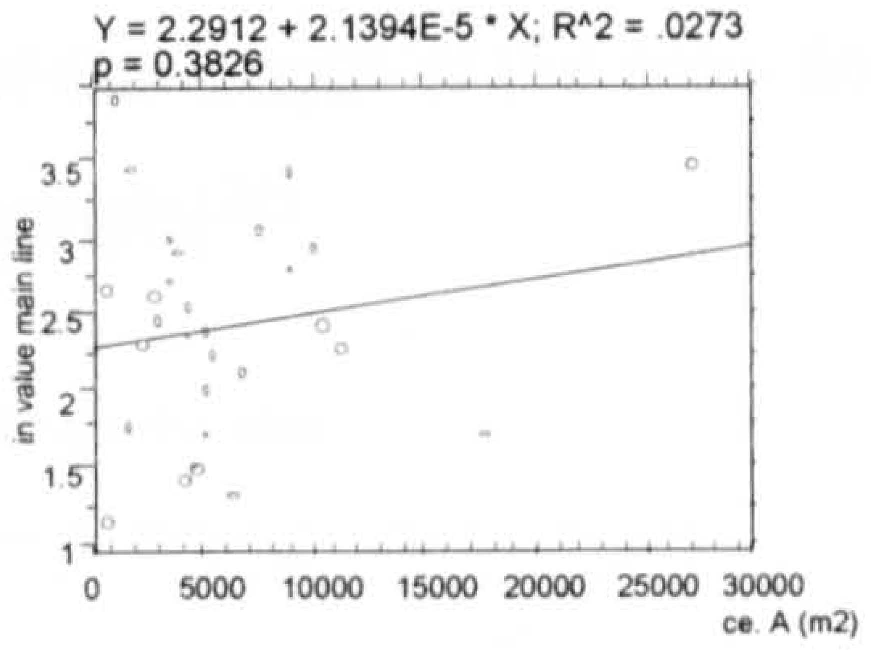

Figure 3.44. Scattergram main convex element area and Rn of main axial line, n = 30

The results show, as for the core sample, the most important factor associated with the main convex element area, as far as the interfacing axial lines are concerned, was the length of the axial lines, being the strategic values also significant. Yet, stepwise regression analysis illustrates that when comparing the area of the main convex element to previously investigated variables, including convex and isovist and interfacing axial lines analyses (30 cases), once more the most significant linkage is the area of the convex isovists, as seen in Plate 3.8.

Stepwise regression summary

main convex element area vs. 11 independent variables

F-to-Enter	4.0000
F-to-Remove	3.9960
Number of Steps	3
Variables Entered	3
Variables Forced	0
Stepwise Procedure	Forward

Stepwise regression summary
Variables in model

main convex element area (m2) vs. 11 independent variables
step: 3

	Coefficient	Std. Error	Std. Coeff.	F-to-Remove
Intercept	536.9592	1223.1997	536.9592	.1927
isovist area	.3871	.0223	.9029	301.3325
visibility ratio	-909.6391	195.7256	-.2744	21.5995
enclosure ratio	1330.7799	403.8516	.1957	10.8585

Stepwise regression summary
Variables not in model

main convex element area vs. 11 independent variables
step: 3

	Partial Cor.	F-to-Enter
sum isov length	-.1179	.3526
mean isov length	.0793	.1581
sum length axial lines	.2168	1.2333
mean length ax.lines	.2884	2.2673
sum nº axial lines	-.0717	.1292
local strategic value	.0590	.0874
strategic value	.1393	.4945
Rn value main line	.3165	2.7839

Multiple regression analysis summary

main convex element area vs. 3 independent variables:
- convex isovist area
- visibility ratio
- enclosure ratio

Count	30
Num. Missing	0
R	.9647
R Squared	.9306
Adjusted R Squared	.9226
RMS Residual	1504.7806

Plate 3.8. Convex and isovist and interfacing axial lines analysis: stepwise and multiple regression analysis summary results

The characterisation of the embedding quality of the urban squares can be further analysed by assessing the relationship between convex isovists and axial lines properties. From the correlation matrix tables (Tables 3.3 and 3.4 in Appendix 1), the data suggests strong linear correlations for the area and the sum of the length of isovists against the sum of the number, length and integration values of the axial lines that interface with the main convex element. From all possibilities, the best correlation was found between the area of the isovist and the sum of the length of the axial lines, illustrated in Figures 3.45 (core sample) and 3.46 (whole sample)[38].

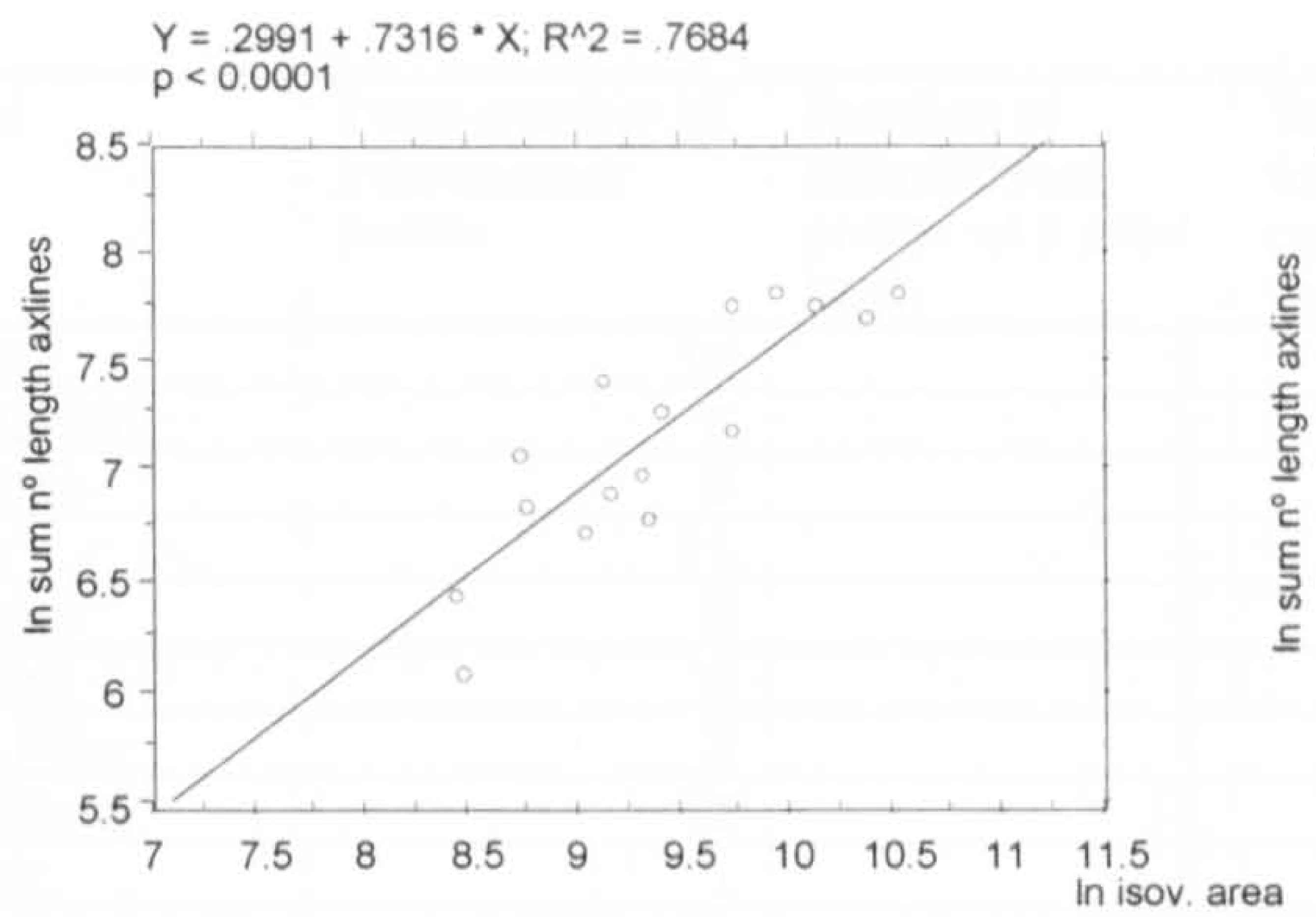

Figure 3.45. Scattergram ln isovist area and ln of the sum of length of axial lines, n = 16

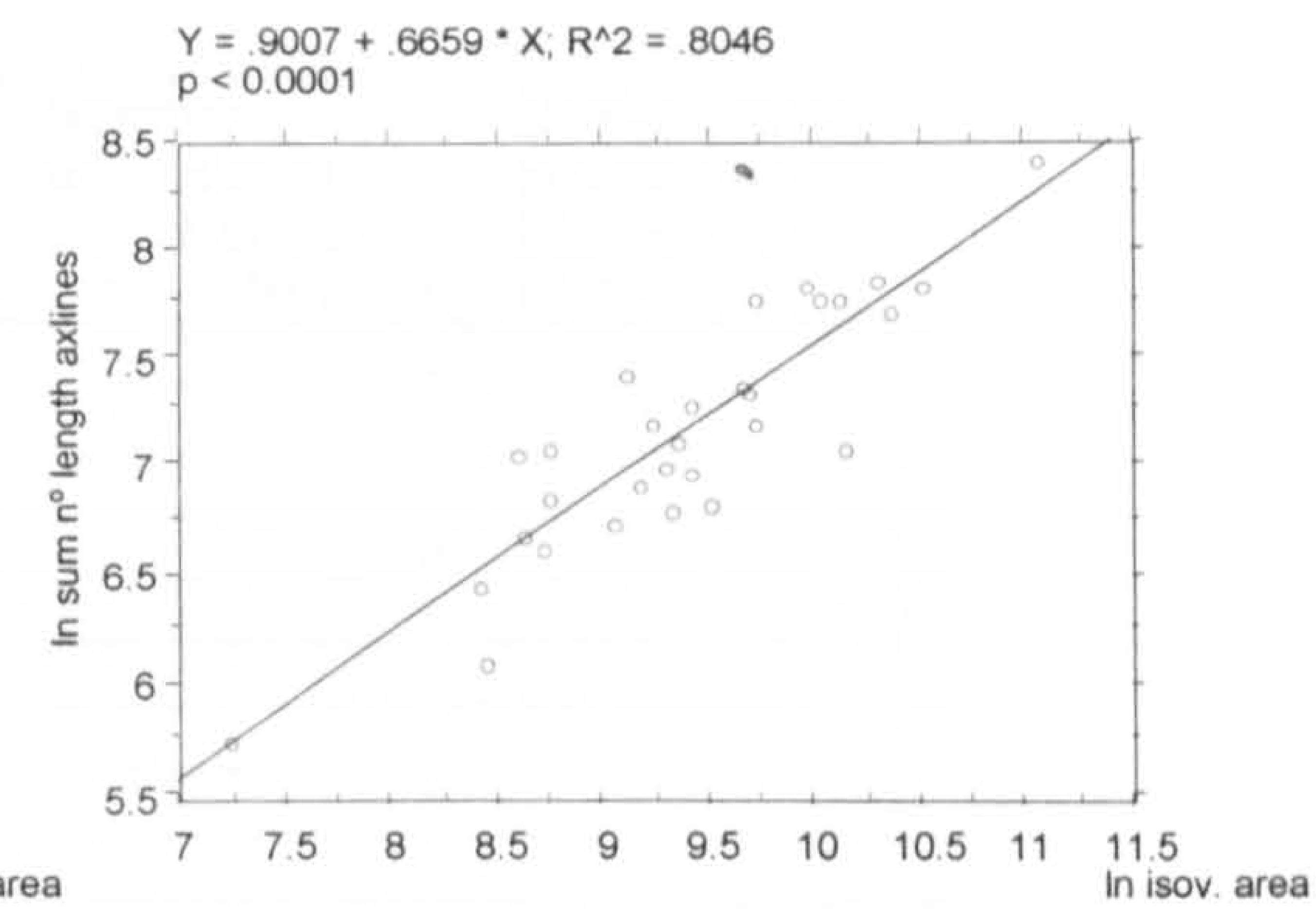

Figure 3.46. Scattergram ln isovist area and ln of sum of length of axial lines, n = 30

The significance of these results is how the visibility and permeability connections of urban squares with the urban environment are constructed. If for the strategic value, only the axial lines that interface with urban squares are important, isovists must interface with urban squares the same way as axial lines. By examining the plans illustrated in Plate 3.3 (Appendix 1), it is clear that from any point inside an isovist, the observer has a good, direct view of the urban square. This rises the possibility that any branches of an isovist which are adjacent to the urban square (as the axial lines that do not go through the body of the urban square, as described by Hillier, 1984) might not be significant for the way urban squares might be used regarding levels of static occupancy.

3.4.2.1. Intersection points

The analysis proceeds by studying whether the axial lines that interface with a main convex element have a tendency to intersect each other and whether there is a preferred location. In addition, it is investigated whether there is a correlation between the number of intersection points and the area of the urban square, based on Hillier's

[38] The data is presented after being normalised by taking the natural log (ln) for both variables.

(et al., 1990a) conjecture that there is a tendency for static occupancy to be close to the intersection of axial lines.

In fact, such a property is expected. If intersection points could be hypothetically associated to the occupation of public spaces, the larger the public space, the more intersection points will be "needed to fill up the space" in a more or less homogeneously pattern. As before, the results are presented first for the core sample, followed by the whole sample. Table 3.11 gives the data used for the analysis for each urban square. Table 3.12, next, summarises the results.

Towns	**Total number of intersection points**	**Number of intersection points of 2 axial lines**	**Number of intersection points of 3 or more axial lines**	**Mean number of axial line per intersection point**
Bruges	12	9	3	2.25
Caernarvon	2	2	0	2.00
Esslingen	6	5	1	2.17
Evora	11	8	3	2.27
Heilbronn	6	6	0	2.00
Kempten	2	1	1	2.50
Kutna Hora	5	4	1	2.20
Magdeburg	13	12	1	2.08
Moguer	1	0	1	3.00
Nijmegen	3	2	1	2.33
Palencia	0	0	0	0
Pest	7	5	2	2.29
S. Gimignano	7	5	2	2.29
Salisbury	2	1	1	2.50
Verdun	5	3	2	2.40
Volkermarkt	3	1	2	2.67
Borgomanero	1	1	0	2.00
Brive	1	1	0	2.00
Castellon	6	5	1	2.17
Groningen	14	10	4	2.29
Gyor	10	9	1	2.10
Kalisz	4	4	0	2.00
Klatovy	5	4	1	2.20
Litomerice	8	4	4	2.50
Modena	4	4	0	2.00
Montauban	5	2	3	2.60
Portalegre	5	4	1	2.20
Scarperia	2	2	0	2.00
Wielun	4	4	0	2.00
Wolfsberg	2	2	0	2.00

Table 3.11. Intersection points data table

Element	**Number of cases**	**Total number of intersection points**	**Number of intersection points for 2 axial lines**	**Number of intersection points for 3 axial lines**	**Mean number points per main convex element**	**Mean number of axial lines per intersection point**
Core sample	16	87	66 (76%)	21 (24%)	5.43	2.33
Whole sample	30	155	119 (77%)	36 (23%)	5.17	2.24
Church	2	3	3	0	1.50	2.00
Main	17	91	64	27	5.36	2.31
Market	7	44	38	6	6.23	2.22
Civic	4	17	14	3	4.25	2.14
Organic	14	79	61	18	5.64	2.30
Semi-regular	9	45	32	13	5.00	2.24
Geometric	7	31	26	05	4.43	2.13

Table 3.12. Number of intersection points summary data

In the core sample, 87 intersection points were identified, 76% of which are of two intersecting axial lines. The remaining 24% consist of 3 or more intersecting axial lines, with an average of 2.33 axial lines per intersection point. There is only one case of 5 intersecting axial lines composing one intersection point (Moguer - Spain). The average total is 5.43 intersection points per main convex element varying from 1 to 13. Considering the intersection points of two intersecting lines in isolation, which make the majority of the sample, there is an average of 4.13 intersection points per main convex element, ranging from zero (the aforementioned town of Moguer has only one intersection point made of the intersection of 5 axial lines) to 12. If we consider three or more intersecting axial lines, there is a decrease in the average number of intersection points per square, but most squares have more than one such intersection, with an average of 1.31 per urban space. When the investigation focused on the location of the intersection points for the core sample, the results showed that there is a tendency for the intersection points to be located at the edge of the main convex elements in 78% of the cases, in contrast to towards the centre in the remaining 22%.

The analysis for the whole sample showed the same pattern with small and statistically insignificant variations for the data compared to the core sample. The whole sample has a total number of 155 intersection points with an average of 5.17 intersection points per main convex element, ranging from 1 to 14. Intersection points composed of just two intersecting axial lines are again in the majority, with 77% ranging from 0 to 12 points per main convex element. For three intersecting axial lines or more the number ranges from 0 to 4. The average number of axial lines intersecting at one intersection point is 2.24 with no main convex element showing more than five intersecting lines per intersection point. The analysis of the whole sample showed that the main convex elements located in the geometric type of urban grids have the highest concentration of intersection points around the edge of the urban space (87%), because of the high number of peripheric axial lines. The analysis also showed that there is no specific pattern that would indicate that axial lines of the same type (convergent, transitional or peripheric) would have a tendency to intersect in any particular way or location. There was no evidence that, for instance, transverse would intersect peripheric axial lines at the edge of the public space or that convergent would intersect transverse axial lines at the centre of the public space.

Lastly, the analysis between the area of the main convex element and the number of intersection points showed a positive linear correlation, as illustrated in Figures 3.47 and 3.48.

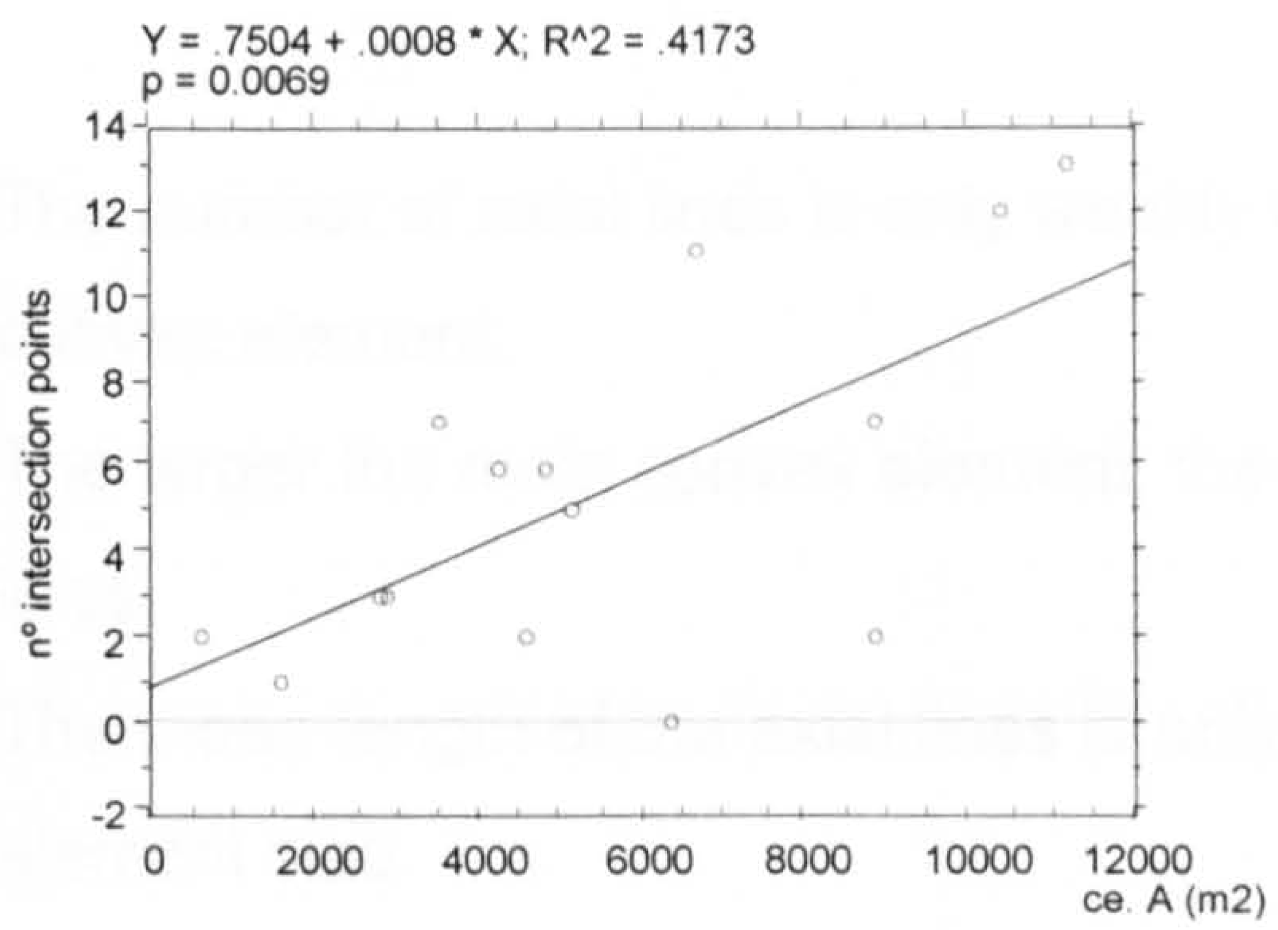

Figure 3.47. Scattergram main convex element area and number of intersection points, n = 16

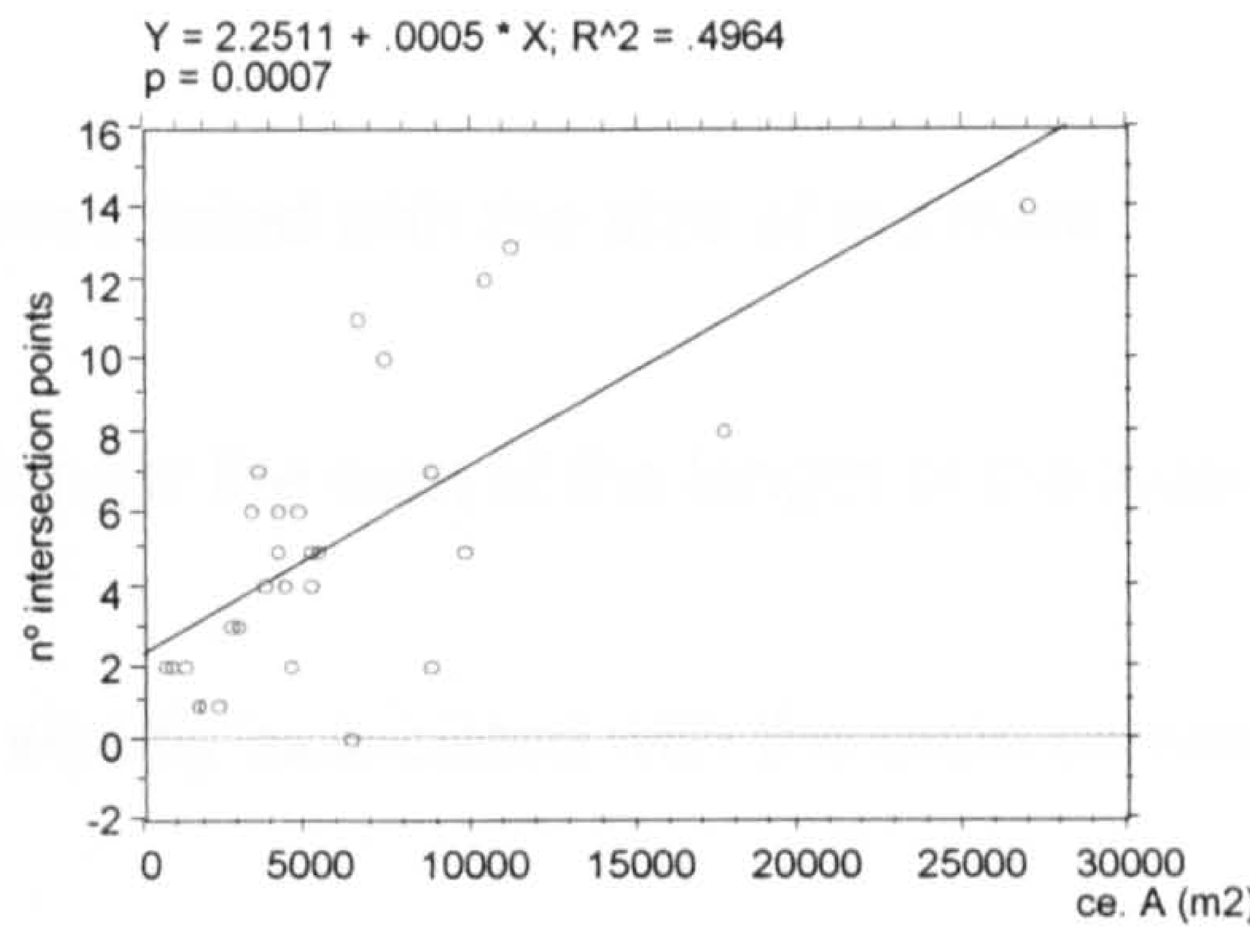

Figure 3.48. Scattergram main convex element area and number of intersection points, n = 30

To summarise, this section has showed some unique trends. If the number of axial lines that intersect at an intersection point might be regarded as low, the number of intersection points are considerably higher with an average of a little more than 5 intersection points per urban space. In other words, it is possible to say that, as far the intersection points are concerned, it is not the intensity (that is, a high concentration of axial lines per point) that is important, but a multiplicity of intersection points distributed inside the public square.

In the case of a preferable distribution of intersection points around the periphery of the main convex elements, this may be significant to the study of the pattern of occupation of the space. When discussing the preferred location of static people, Hillier claimed that good locations for unprogrammed static use were found to be those which were convexly related to the intersections of axial lines (Hillier et al., 1990a, p6). In this case, the edge effect (Gehl, 1987) regarding the outside to inside occupation of public spaces might be associated with the proximity of the intersection points in line with Hillier's ideas. However, the number and distribution of the intersection points challenges Sitte's suggestion that because of the enclosure property, only a single view would be possible from any point within the public space at a time. The intersection points of axial lines, even for the convergent ones, implied in double vistas and consequent continuity. It confirms that urban squares, despite being surrounded by buildings, retain strong access and visual connections.

Therefore, it has been suggested that for both core and whole samples:

- The number of axial lines is only weakly associated with the size of the main convex element.
- The larger the main convex element, the longer the sum of the length of the axial lines.
- The mean length of the axial lines is only weakly associated with the main convex element size.
- The strategic value and the local strategic values are only weakly associated with the size of the main convex element.
- The integration value of the main line that interfaces with the main convex element is independent of its size.
- The visual and permeability properties of the main convex element correlate with each other.
- The distinction between the different types of axial lines, due to their irregular incidence in the various main convex elements, has so far showed to have a less broad application. However, it confirms Sitte's proposition on the absence of views from urban square entry points.
- The axial lines which interface with the main convex element tend to intercept at the edges of the space, with many intersections involving two axial lines only.
- The larger the main convex element, the higher the number of intersection points.

3.4.3. EMBEDDING ANALYSIS

An another important aspect to address is whether urban squares work as strategic spaces, by means of an analysis of their syntactic characteristics in the large scale of their embedding in the town structure, focussing on:

- The depth of the lines that interface with the main convex element with respect to the most globally integrated line of respective town.
- The integration values of the axial lines that interface with the main convex element in relation to the 10% most integrated lines of their respective towns.
- The global integration value of the main convex element in relation to the global integration values of the axial lines of its urban context.

Towns	Depth of main line	% axial lines in the integration core	Rn value ce	Mean Rn value town	Rn value ce R
Bruges	1	100	2.1647	1.3409	1.6144
Caernarvon	1	66	1.6694	1.3222	1.2626
Esslingen	2	60	1.3318	1.0013	1.3301
Evora	1	100	1.8281	1.2574	1.4539
Heilbronn	2	40	1.8354	1.5922	1.1527
Kempten	5	0	1.1549	1.7097	0.6755
Kutna Hora	1	100	1.9140	1.2284	1.5581
Magdeburg	2	11	1.7208	1.5163	1.1349
Moguer	1	100	1.4986	1.2161	1.2323
Nijmegen	2	75	1.7993	1.4767	1.2185
Palencia	3	0	1.0624	1.1982	0.8866
Pest	1	33	1.8876	1.7005	1.1100
S. Gimignano	1	63	1.9960	1.4653	1.3622
Salisbury	1	50	2.0463	2.0905	0.9789
Verdun	1	17	1.1748	1.0241	1.1472
Volkermarkt	1	60	1.9364	1.5175	1.2760
Borgomanero	1	50	1.6813	1.7836	0.9426
Brive	1	60	1.8920	1.3461	1.4055
Castellon	3	0	2.1786	2.2635	0.9625
Groningen	1	88	2.5914	1.9014	1.3629
Gyor	1	57	2.4235	1.7850	1.3577
Kalisz	1	75	1.6535	1.5253	1.0840
Klatovy	2	50	2.0277	2.2889	0.8859
Litomerice	2	38	1.4515	1.1034	1.3155
Modena	2	25	1.8385	1.7183	1.0700
Montauban	2	0	2.0723	1.7612	1.1766
Portalegre	2	40	1.2233	1.1000	1.1121
Scarperia	1	67	1.8186	1.8557	0.9800
Wielun	1	50	2.2088	1.8725	1.1796
Wolfsberg	2	33	0.9823	0.8240	1.1921

Table 3.13. Embedding analysis data table

For the depth analysis, for the core sample, the results showed that in 62.5% of the cases, the most integrated line of the system is also the most integrated line that interfaces with the main convex element, whether or not it is a convergent, transverse or peripheric axial line. In addition, in another 25% of cases, the most integrated line of the main convex element is only one step away from the most integrated line of the urban fabric[39]. This illustrates just how axially shallow they are in the system. The depth analysis for the whole sample showed the same properties found in the core sample. The results showed that in 57% of cases, the most integrated line of the system is that which interfaces with the main convex element. In addition, another 33% have their most integrated line only one step away from the most integrated line of the urban system.

[39] Refer to "Depth of main line" column in Table 3.13. The number 1 means that the most globally integrated line that interfaces with the main convex element is also the most integrated line of the system. Number 2 means that most integrated line that interfaces with the main convex element is one step away from the most integrated line of the urban system, number 3, two steps away, and so on.

The embedding analysis was carried out by examining the relationship between local and global integration values of axial lines that interface with the main convex element in relation to the main axial lines of the urban system through what it is named the "embedding scattergrams". The embedding scattergrams showed that the axial lines interfacing with the main convex element, when not part of the main integration core, were in most cases in a "secondary integration core" area, defined by the area between the integration core and the mean integration for the town, schematically illustrated in Figure 3.49. Figures 3.50 illustrates the embedding in the town of Esslingen, where the black dots indicate the axial lines that interface with the main convex element. Scattergrams showing the correlation between radius-3 and radius-n integration for the whole sample are given in Plate 3.9 of Appendix 1. The results will be presented for the whole sample only.

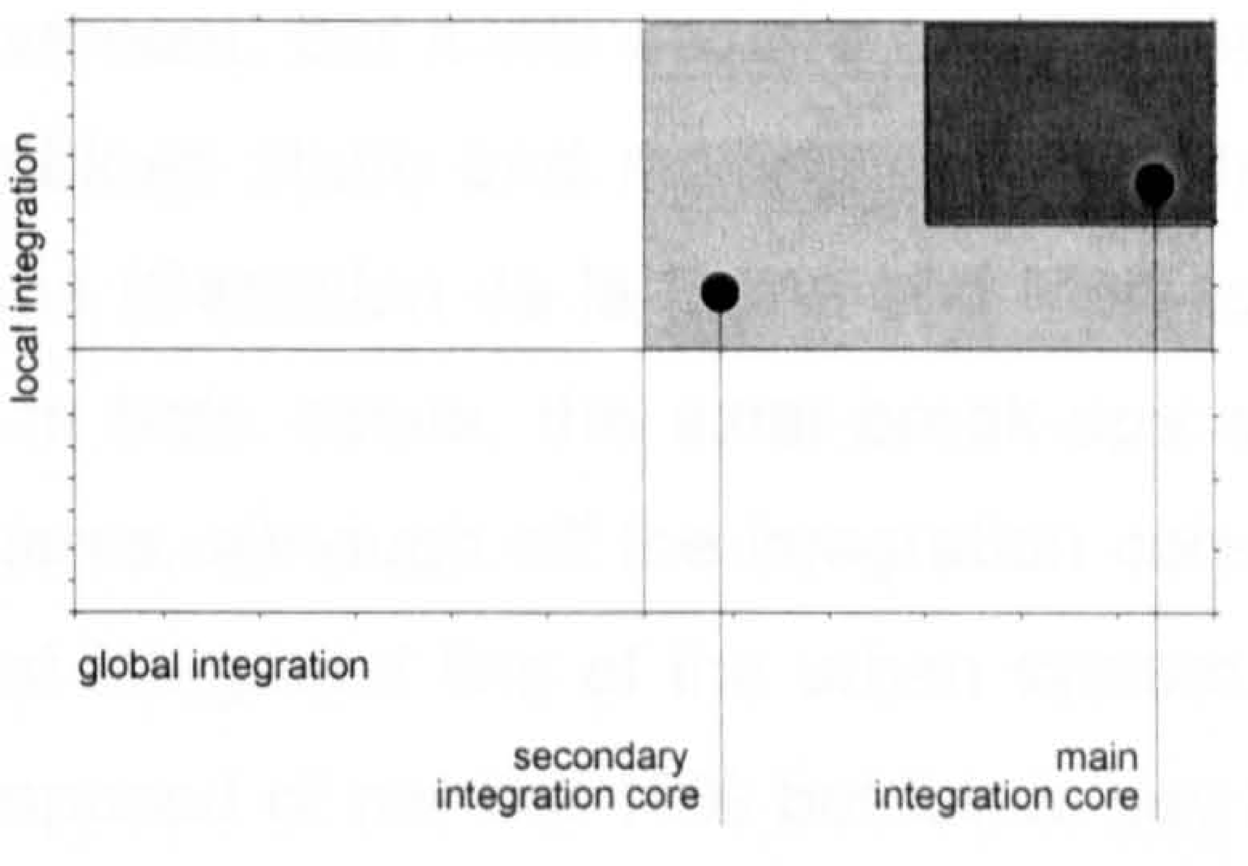

Figure 3.49. Embedding scattergram

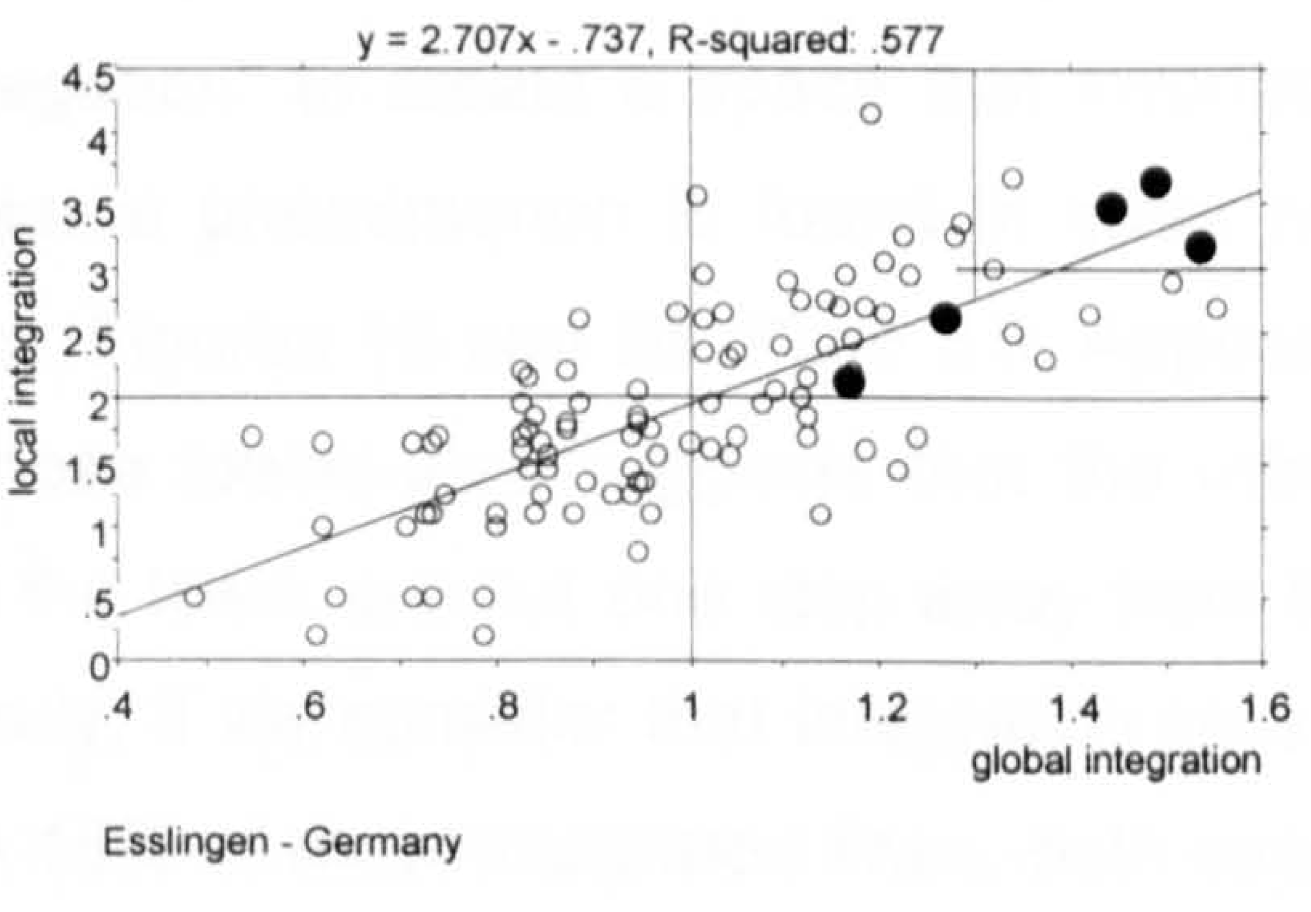

Figure 3.50. Esslingen embedding scattergram

Analysis of the scattergrams shows that if the main convex element is not flooded with highly local and globally integrated lines, it is still embedded enough to give a general awareness of how the square fits within a global context, whilst at the same time preserving enough syntactic distance or segregation with respect to the surrounding areas to prevent the space from becoming over-populated for its location. What, perhaps, is significant for the urban square is that it must combine moving and static people. Urban squares are easily accessible but must keep a certain degree of privacy. There are also examples of urban squares that present a few poorly integrated lines. The examples show that most of these lines are less important side streets. Due to axial break up, some of them are very localised lines. Not surprisingly, they are the shortest ones, and generally belong to the convergent axial lines category.

Analysis of the embedding scattergrams also showed that, although urban squares have been shown to have lines with a good balance for both local and global integration values, on a few occasions axial lines were found over performing at local level (Figs. 24 and 30, Plate 3.9, Appendix 1), suggesting that the axial lines that interface with the urban squares are more significant at local levels. At the same time, there were no cases of highly locally integrated axial lines with poor global integration values. However, there are a few cases that did not follow the general trend that must be looked at which, in fact, confirm the findings above.

There is one case (Palencia; Figure 11, Plate 3.9, Appendix 1) with all axial lines in the secondary integration core. When analysing the town plan, it was noticed that, although none of the axial lines that interface with the urban square are in the integration core, they were only one step away from the most integrated line of the urban system, which seems to be a major access line to the outside of the town, probably a very busy traffic road. Again, it is suggested that there is strong logic behind it. Being one step away, the square will be very close to main lines of pedestrian movement, but it will acquire enough "segregation" to create a space that invariably combines static and moving people. The same phenomenon is found in other two towns (Castellon de la Plana and Montauban; Figures 19 and 26, Plate 3.9, Appendix 1). In both cases, the axial break-ups of those towns also suggests that the urban squares, although off the integration core of the town, are but one step away from the most integrated line of the urban system. Truly, if we consider that integration core is composed of not the 10% but let us say the 15% of most integrated lines, both cases will then have lines in the main integration core.

The analysis showed that there is only one town (Kempten, Figure 6, Plate 3.9, Appendix 1) where the urban square showed a poor degree of both local and global integration. On re-examination of the original town plan, it was clear that there is another urban square where the Town Hall is located which is in fact in the integration core of the town. Therefore, overall it is possible to say that urban squares are generally located in the integration core. Particularly in this town, naturally different urban squares will probably be located in areas which have different degrees of integration; that is, intuitively it would be possible to say that market squares tend to be in better integrated areas, whereas perhaps church squares tend to be located in more segregated areas. Hillier argues that "towns give priority to certain spaces: the main square or common High Street will tend to be shallower and thus more generally accessible than more secluded, deeper, quiet areas. Major commercial and public facilities will be within easy reach of other parts of town" (Hillier, et al., 1983, p54). This proposal is in agreement with Zucker (1959), who also argues that Town Hall and church squares are located free of lines of traffic. In fact, another explanation suggests that a slightly different interpretation of the axial break up would lead to perhaps a more realistic integration pattern. The lines interfacing with the urban square, although not in the integration core, will be in the "secondary integration core" falling in the discussion of the three cases above. Nevertheless, Kempten is a unique case and at any level challenges the findings discussed previously.

In summary, for the core sample, with only a few exceptions (13% of all cases), all the main convex elements had at least one axial line as part of the integration core. In fact, urban squares had, on average, 50.3% of their axial lines inserted in the integration core and 85% of all lines are above the mean integration of the system. This suggests that the pattern cannot be accidental and confirms a powerful relation between spatially and social integrated spaces. When analysing the integration core for the whole sample, 87% of all 30 cases had at least one axial line as part of the integration core, with an average of 54.7% of their axial lines in the urban core, and 89% of all lines are above the mean integration of the system.

3.4.3.1. Comparing the integration value of the urban square to the axial lines of the system

There is another way of investigating how likely the urban square is to be present in everybody's routes by comparing the integration value of the main convex element to the axial lines of its urban system. Because of the nature of the analysis, it would be expected that the integration value of the main convex element would be significantly lower compared to the integration values of the axial lines of the overall system[40]. The results were quite promising, revealing a strong indication of the presence of the public space in the global pattern of pedestrian movement. Despite the problems discussed above, in 30% of the cases the integration value of the urban square is within the group of 10% most integrated axial lines of the urban system, and 81% of urban squares have their integration values above the mean integration of the system. When the analysis was applied to the whole sample, with all 30 cases included, the general trend was maintained. The number of urban square global integration values above the mean integration values of the urban system represents 77% of all cases and 23% are within the main integration core.

[40] Theoretically the main convex element could have a relatively segregated value because it is a convex space represented as a line, therefore with a much smaller number of connections.

A second analysis was carried out comparing the integration values of urban squares across the sample to investigate if they would incorporate other properties such as a higher number of axial lines interfacing with the main convex element or the extent of isovist fields. There was a problem here. Due to the particularities of each town, which it is not the objective of this research to examine, it was noticed that in a few cases although the main convex element had a high integration value, in fact it was much more segregated compared to the whole system than another convex element in the same position with a much lower integration value. In order to "relativise" the integration values, the integration value of the main convex element was divided by the mean integration value of the town[41] and therefore it was possible to compare the different values across the sample[42]. The values for the core sample range from 0.675 to 1.6144 (the higher the value, the more integrated the space). For the core and whole samples, the 25% most integrated convex elements with high global integration values were selected and analysed against all the variables compiled in this study and no significant variations such as a higher incidence of convergent axial lines, a higher average area for the urban square or isovists could be established, not could it for the whole sample.

The integration value of the main convex element against its respective size did not show a linear correlation for both cases, the core (Fig. 3.51) and the whole sample (Fig. 3.52). The scattergram for the global integration value of the main convex element and its area shows clearly that independently of the area of the main convex element, the integration value of the main convex element tends to be within a group range.

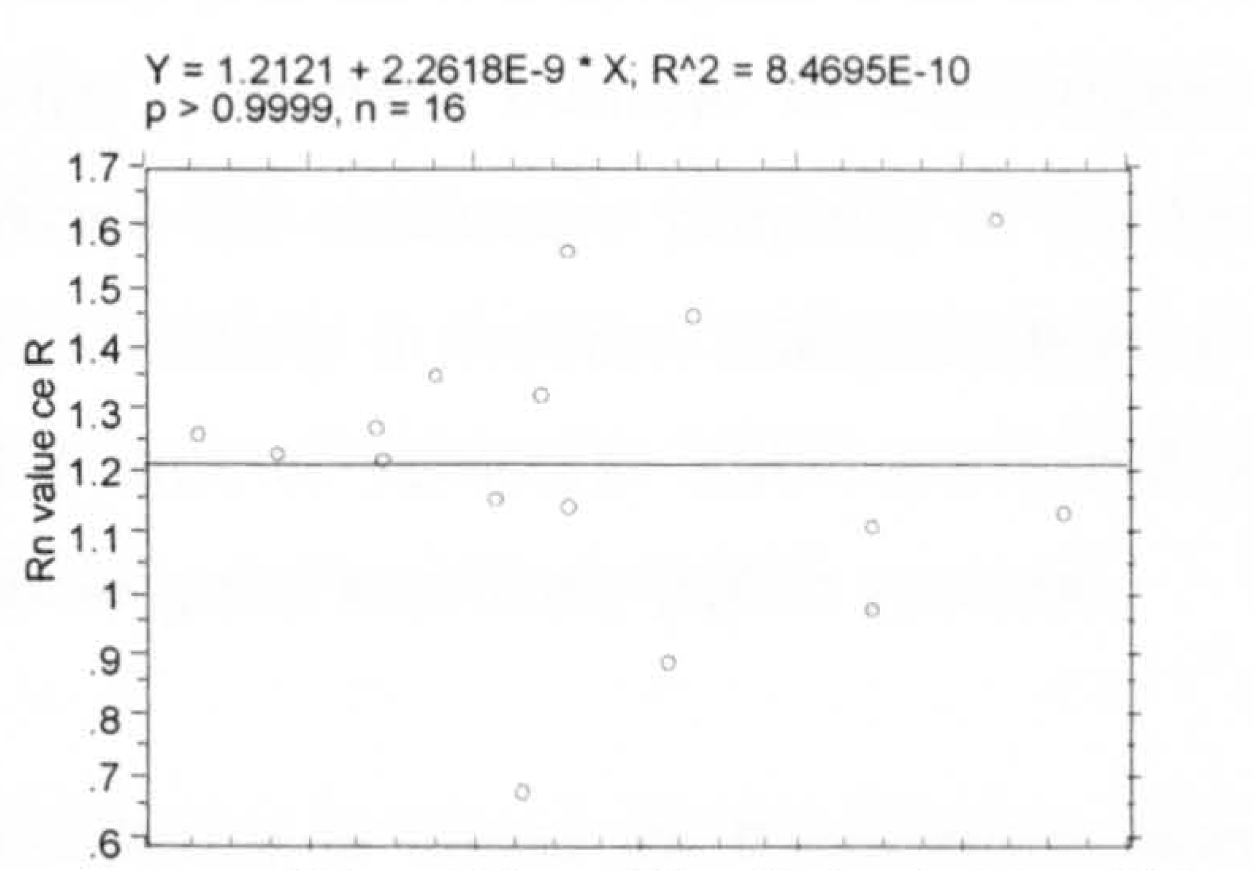

Fig. 3.51. Scattergram main convex element area and Rn of main convex element (R), n = 16

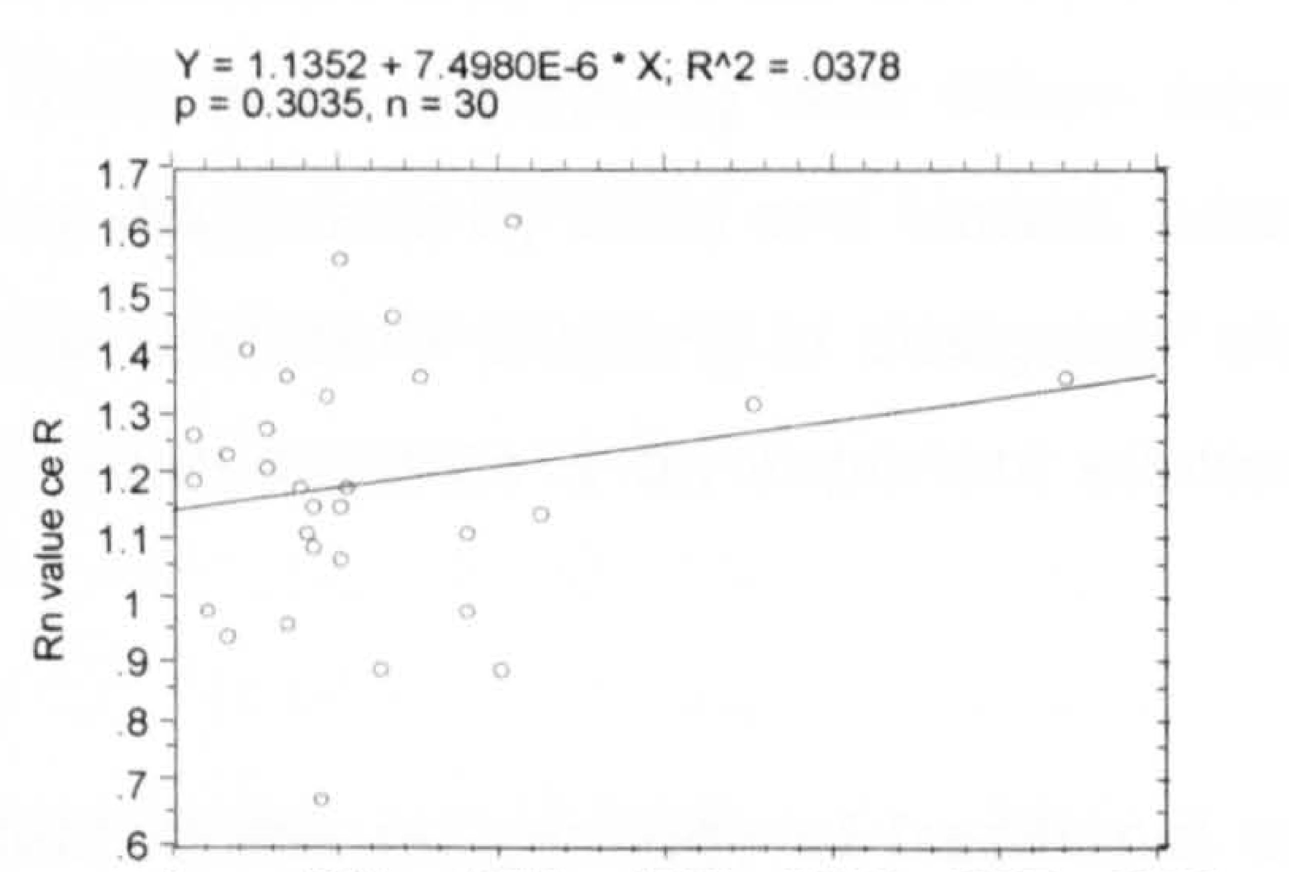

Fig. 3.52. Scattergram main convex element area and Rn of main convex element (R), n = 30

[41] Referred to as " Rn value town" in Table 3.13 and general data Table 3.2 in Appendix 1.

[42] Referred to as "Rn value ce R" in Table 3.13 and general data Table 3.2 in Appendix 1.

For the embedding analysis, it has been found that:

- The majority of the axial lines that interface with the main convex element belong to the 10% integration core.
- In the majority of cases, the integration values of the main convex element are above the mean integration value of their respective towns.
- Only in the minority of the cases, are the integration values of the main convex element part of the 10% integration core of respective towns.
- The integration value of the main convex element is independent of its size.

3.5. DISCUSSION AND CONCLUSIONS

The investigation showed a strong correlation between the location of urban squares and the spatial structure of the urban grid, as well as a series of common morphological characteristics that may play an important role in the performance of urban public spaces.

Initially, it was recognised from the analysis of the main convex element defining the urban square that, although obviously varying in size, urban squares keep to a certain range, as do the isovists from within the space. In addition, an "enclosure" property was identified, since the selected cases were shown to have on average a built perimeter almost twice as large as the unbuilt one. The plans also showed that, from the entry points, the opposite side of the urban square was often blocked by a building façade. The high number of convergent axial lines interfacing with urban squares confirms the enclosure property in the terms discussed by Sitte and Unwin, amongst others, where a modern interpretation of the enclosure property is designers' claims that a lack of vehicular traffic surrounding urban squares is an important element to achieve good and lively public spaces.

If enclosure is found as a common element in the morphology of traditional urban squares, and maybe it does create a pleasant feeling, the findings also suggest that there is a countervailing tendency where urban squares embody strong visual links with the urban environment as illustrated by the visibility ratio. The visibility ratio showed that on average the size of the convex isovists is three times the size of the main convex element. Within a certain range, urban squares incorporate a domain within their hinterland, which is in proportion to their size, in so far as bigger spaces will stretch their visual connections further. This is confirmed by a positive correlation between the area of the main convex element and the area of the convex isovist (the most relevant one) and the sum of the length of isovists. This suggests that traditional squares were not as "enclosed" as previously thought. Most importantly, the enclosure property may not be enough to ensure that the urban square is well used since, before having people make use of the space, they have to arrive there.

Still investigating the access and visual links of urban squares with the urban environment, the differentiation of axial lines showed an interesting result. There was a high concentration of axial lines that terminate within the spatial limits of the main convex element in comparison to the other two types, that is, transverse and peripheric axial lines, which are prolonged further. When transverse and peripheric axial lines cross the urban square, the tendency is for this to occur at the periphery of the space, so as not to interfere with the dynamics of the space which combines static and moving people. However, the analysis between the size of the main convex space and axial lines showed that, apart from the positive correlation between the sum of the lengths of the axial lines, all the other properties are very weakly associated with the size of the main convex element (the sum of the number of axial lines, the mean sum of the length of the axial lines, strategic value and local strategic value) or not associated at all (the global integration value of the main line).

The sample showed that urban squares also have the important additional property of being strategically located in the urban fabric and this strategic location is backed up by a strong logic, in which spatial elements and social factors are closed related. The investigation showed that not only is it important for urban squares to be at the interface with the main lines of pedestrian movement, but also to keep a balance and have part of their spatial elements in more segregated areas to create a homogeneous balance for static and moving people. The links are expressed in support of the previously identified integration value of the main convex element, as urban squares are bound to be present in everybody's daily routes. This is supported by the good correlation between convex isovists and the number of axial lines that interface with the main convex element. This also gives an indication of how far urban square interacts with the environment whether or not the large scale structure of the town can been seen within the space through the isovist connections.

The importance of these findings for this study is, of course, that in his concept of the strategic location of a square and its strategic value, Hillier had identified a very similar, though not identical, property to the one established earlier in this chapter. A square's embeddeness as seen in terms of the sum of the lengths of a square's isovist that are extended into the surrounding urban fabric is a similar, though not identical, property to its embeddedness within the axial structure of the urban grid. The difference lies in the fact that the axial connectedness of the square is a global property of the grid, defined by tracing all the longest lines of sight and access in the street system in order to look at how they interface with the main convex element of the square locally, whereas the longest lines extending out from the isovist are a local property of the space itself. When the plans of a sample of squares from traditional towns were examined to establish the generality of Hillier's proposition on the importance of strategic value, it was found that here too squares and larger open spaces acted as intersection points for axial lines so that the open space was in a strategic position with respect to the surrounding system, and the strategic location of a space was usually in proportion to the size of the urban space.

Concerning the intersection points of axial lines, the results showed that most of them are located at the periphery of the urban space, with a multiplicity of intersection points rather than an intensity of intersecting axial lines per point. The location at the periphery probably indicates a first level of access and visual links. The multiplicity of points at the outer limits of urban squares is related to the edge effect and a uniform occupation of the space with implications for preferable locations for non programmed static use of the space, as described by Alexander et al. (1977), Gehl (1987) and others.

Consequently, it is possible to say that, despite being enclosed entities, urban squares in traditional towns managed to have enough permeability and visual links with their surroundings, which may be important to secure good levels of static and movement rates. In addition, the fact that these properties were found for urban squares of different social functions, and in grids with different degrees of regularity, suggests strong underlying social factors. For urban squares, probably an important focus for social life, strong visual and access links with the urban environment was a not a coincidence but more likely an imperative property for their "success".

This investigation was able to identify some important morphological characteristics for traditional urban squares, mainly regarding their form and embedding in the urban fabric. It is also clear that these findings open many fields for further investigation. The next step is to study how far the characteristics, which were established for traditional squares, are present in a sample of contemporary in-use public spaces. It will then be possible, by collecting data on the performance of contemporary examples, to see if the morphological characteristics found in both samples are relevant to the performance of public spaces.

4

THE MORPHOLOGY OF PUBLIC SPACES IN THE CITY OF LONDON

The morphological properties of twelve public spaces in the City of London are analysed and discussed in this chapter. The study investigates how far common morphological characteristics can be found for the selected cases, and to what extent they were previously identified in the sample of traditional squares of European cities. These findings will provide the basic theoretical framework for the subsequent study of the relationship between patterns of spatial use and spatial design for the "in-use" public spaces in the City of London. This chapter is structured in three stages: the first stage includes a description of the inventory of public spaces in the City of London, followed by the criteria used for selecting a representative sample, and a history and spatial description of the selected cases. The second stage discusses the methodology employed for the analysis of the morphological properties. The last stage, using the same methodology as Chapter 3, focuses on the convex and isovist, interfacing axial lines and embedding analysis, concluding by discussing to what extent both samples share morphological characteristics.

4.1. SURVEYING PUBLIC SPACES IN THE CITY OF LONDON

In 1992, Plummer and Shewan published the results of an inventory of open spaces in the City of London carried out during 1982 and 1983[1]. Their survey, which included green spaces, hard spaces and street gardens[2], both private and accessible to the public, covered 357 open spaces. The City of London was then compared to two adjacent neighbourhoods of approximately equal size: the West End (83 open spaces) to the west and Tower Hamlets (334 open spaces), which is a predominantly residential area, to the east[3]. The research showed, amongst other things, that the City of London has over four times as many open spaces as the West End. Plummer and Shewan concluded: "Contrary to what could be expected within a heavily built up financial centre, The City of London shows a comparatively large number of green open spaces when compared to its immediate neighbours" (Plummer and Shewan, op.cit., p29). The same trend is found for hard surface areas, where the survey on the City showed 125 spaces compared to 55 in the West End (Ibid., p29).

The City of London was chosen because it provides a satisfactory basis for a comparative empirical study of the performance of public spaces on account of three main reasons. Firstly, from Plummer and Shewan's survey, it became clear that the City of London was likely to have enough cases to compose a good sample where the ideas on the necessary spatial elements for successful urban spaces could be tested. Secondly, Hillier (1984; et al., 1990), in two previous studies on the performance of public spaces in the City of London, had already identified open spaces with different degrees of informal use. Thirdly, it is advantageous select spaces which are all part of the same urban spatial culture, to enable social variables specific to an environment to be discounted.

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[1] The survey was carried out by students from the former City of London Polytechnic, Polytechnic of Central London and University of Guelph (Canada) as part of an academic exercise in urban conservation and ecology.

[2] The open spaces were "categorized as hard (with a predominantly hard floorscape), green (with a predominantly soft floorscape: grass, flower beds, shrubberies, and so on) and street gardens (predominantly small planted linear areas forming an integral part of the City's pavement features and including areas planted to divide traffic flows, pedestrian or vehicular)." (Plummer and Shewan, 1992, p17).

[3] The comparison does not limit itself to numbers, the open spaces are also compared according to type and size.

A new survey was carried out as part of this research[4]. Plummer and Shewan's original survey was conducted more than ten years ago and many changes were likely to have occurred in the urban fabric. The survey used Oliver's Map of the City of London[5] as a starting point. All the open public spaces that were identified from the map were inspected and assessed for their suitability. The selected area followed approximately the City of London's administrative boundary (Fig. 4.1). The survey of open spaces in the City of London was carried out during late February and March 1996. In total, 132 spaces were surveyed. From the 132 areas surveyed, 97 were eliminated because they are currently being used for other purposes, such as car parks, or because they are either privately owned or have restricted access to the public.

The remaining 35 open spaces[6] exhibited a varied range of spatial characteristics. The survey showed a high number of churchyards now being used as public spaces[7] (such as St. Anne & St. Agnes churchyard, Bow churchyard, St Mary Aldermary churchyard, St. Michael's Alley, and St. Helen Bishopgate). Also, there were quite a few open spaces which have been built within the last three decades (Paternoster Square, Britannic Tower, Broadgate Circus, Commercial Union, and Beaufort House Square). Some spaces could be characterised as highly open to their surroundings (Bank Corner and New Change/Cheapside Corner) in contrast to those such as Mitre Court, which is a completely enclosed area. There is one sunken plaza (opposite St. Anne & St. Agnes churchyard), and at least two above street level (North Guildhall and Exchange Square).

A small number of public spaces were found to have a poor quality, limited number of seats (Paternoster Square, Britannic Tower, Commercial Union) whereas others contained adequate seating (St. Anne & St. Agnes churchyard, Whittington Gardens and St. Michael's Alley). There were cases where the bulk of the seats were located in the inner area of the public space (Bank Corner) in contrast to some where the seating areas were predominantly at the edge of the public space (NE St. Paul's).

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[4] In fact, Plummer and Shewan's study is not a directory of the City of London's open spaces. Many cases are presented and discussed but there is no index of all the 357 mentioned spaces.

[5] Approximate scale: 1:3669; edition: 26 February 1990.

[6] The public spaces mentioned next are shown in Figure 4.51 at the end of this chapter.

[7] See Rivers and Streatfield, 1987.

Preliminary observation showed that there were a number of spaces where the majority of pedestrian movement crosses the space, such as the Royal Exchange and Beaufort House Square. In other cases, the main pedestrian movement is adjacent to the site (Carter Lane, Abchurchyard or Fencourt). In addition, spaces were noticed where pedestrians could walk across almost freely inside, such as Exchange Square or Fenchurch Place. These contrast with spaces where pedestrian movement is quite restricted due to the arrangement of street furniture, such as NE St. Paul's, Love Lane Corner or Yard of Bishopgate. Although a high number of open spaces have at least one pub or wine bar opposite or very close by, there are public spaces that seem to be very successful even though there are no shops in the immediate surroundings, such as NE St. Paul's and Bank Corner. Elsewhere, such as at Paternoster Square, many shops seem to have shut down due to a lack of customers.

Finally, there were locations not designed to be used as "public squares" which turned out to be very successful, like the informal space opposite Moor House (containing hardly any adequate seating). In contrast, some public spaces such as those at Britannic Tower, Chase Manhattan Bank or Tower Place which were designed with a clear intention to work as lively urban public spaces with "careful" planning, appeared to be extremely under-used.

4.2. CRITERIA FOR SELECTION OF PUBLIC SPACES

The next task was to compose a representative sample from the remaining 35 cases, by collecting empirical data, in order to assess their performance and thereby establish which morphological properties are relevant for their success. Since it is conjectured that the level and distribution of static people are primarily a function of the degree of access and visibility between the public space and the configuration of the urban fabric and not solely based on its geometry or internal layout, the final sample should also incorporate elements previously suggested in the literature review (Chapter 2) to produce highly successful public spaces.

It was important also to incorporate in the sample a variation of morphological cases from different areas in the City of London. This includes modern and traditional cases, some purpose built and some not, as well as enclosed spaces and spaces with large visual connections with the surroundings. Other aspects to be explored were the quantity and location of seats, the degree of freedom for pedestrians when walking through the spaces and the presence of catering and/or retail establishments. Finally, a selection of examples with "apparently"[8] different levels of spatial use were also to be included, although no systematic observation had been carried out at the time. At this point, no space syntax measures were examined. On the basis of these specific parameters, twelve spaces were selected to give a representative cross-section of the 35 cases. The selected public spaces are: Abchurchyard, Bank Corner, Exchange Square, Fenchurch Place, Finsbury Av., Fleet Place, Love Lane Corner, New Change/Cheapside Corner, North Guildhall, Royal Exchange, St Anne & St. Agnes churchyard and Whittington Gardens. Figure 4.1 shows the selected public spaces (in yellow) in addition to some reference points in the area.

4.3. CITY OF LONDON SELECTED PUBLIC SPACES: HISTORICAL AND SPATIAL DESCRIPTION

The key elements of each public space are summarised in Table 4.1 below. A more detailed description follows with an ethnographical portrait of public spaces' historical background and spatial description.

Public space name	Public space area (m2)	Origin	Recent develop ment[9]	Purpo se built[10]	Level of enclosu-re	Quality of street furniture	Degree of pedestr. freedom	Cate-ring facili ties	Level of static people
Abchurchyard	322.99	former churchyard	no	no	high	poor	good	yes	low
Bank Corner	1019.85	building development	no	yes	low	medium	poor	no	good
Exchange Sq.	6371.41	office complex	yes	yes	high	good	medium	yes	good
Fenchurch Place	830.98	building development	yes	yes	medium	medium	good	yes	medium
Finsbury Av.	2957.79	office complex	yes	yes	high	good	medium	yes	good
Fleet Place	1493.24	office complex	yes	yes	high	medium	good	yes	medium
Love Lane Corner	918.74	former church site	no	no	medium	good	poor	no	good
New Change	288.61	building develp.	yes	yes	low	medium	poor	yes	medium
North Guildhall	1666.82	building development	yes	yes	medium	poor	good	no	low
Royal Exchange	1170.33	building development	no	yes	medium	medium	good	yes	good
St.Anne & St.Agnes	1095.90	former churchyard	no	no	medium	good	poor	no	low
Whittington Gardens	984.30	former churchyard	no	no	medium	good	poor	yes	medium

Table 4.1. Summary of key elements

8 During the preliminary field inspection, public spaces which were visited during lunchtime were found to have different levels of static occupancy.

9 Public spaces which were built in the last one hundred years.

10 The no-purpose built public spaces are the ones which occupy the site originally designated to other functions.

Figure 4.1. City of London plan with selected public spaces and reference points
not to scale - reference onbly

4.3.1. Abchurchyard

Abchurchyard was originally the burial ground attached to the church of St. Mary Ab, which was rebuilt in 1686 by Christopher Wren to replace an ancient church destroyed in the 1666 Great Fire[11]. Abchurchyard is located in the centre of the City directly below Bank Corner and north of the River Thames (Figs. A and B, Plate 4.1 in Appendix 2)[12]. It is a short walk from Cannon Street and Monument underground stations and London and Southwark bridges. Abchurchyard is positioned between two major road arteries in the City of London: King William and Cannon Street. It can be reached from the west by a small and narrow pedestrian alley called Sheborne Lane. From the east side access is via Abchurch Lane, a much busier street, compared to Sheborne Lane, as far as the level of pedestrian movement is concerned (Figs. B and C, Plate 4.1). Abchurch Lane is a popular route for City workers who arrive at Cannon Street train and underground station and walk north towards the Bank area. Conversely, the level of vehicular movement is low and is restricted to cars or small delivery vans since the road itself is quite narrow.

Abchurchyard is an example of a space formed against walls of the surrounding buildings. The open space approximates a square shape and three of its four façades are part of buildings. It keeps the original design of the burial ground. It is a typical hard surface public space at street level with a few wooden benches by the church entrance (Figs. C and D, Plate 4.1). It does not have any kind of vegetation or significant decorative elements, apart from the mosaic style floor and iron bollards surrounding the space in an attempt to create a distinction between the open space and pedestrian routes. Because the open space is virtually cleared of any kind of street furniture, pedestrians have the freedom to choose any path they wish when crossing the space. Abchurchyard is also a typical example of an enclosed property according to Sitte's definition, since from both entry points the user faces a blank façade.

Abchurchyard is the second smallest, as far as the geometric area is concerned, of all the twelve selected public spaces. Although small in size, Abchurchyard is well served by catering facilities. There is a wine bar that faces directly onto the open space (Figs.

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[11] All the historical information for the twelve selected public spaces were taken from Acres, 1923; Borer, 1962; Bradley and Pevsner, 1997; Bruce, 1931; Carrier and Dick, 1957; and Tames, 1995. In addition, information was collected from the archives of the Corporation of London Records Office and photographs from the archives of the Royal Commission of the Historical Monuments of England.

[12] Plates 4.1 to 4.12 are found in Appendix 2.

B and E, Plate 4.1). In addition, in Cannon Street, which is about 10 metres away, there are many sandwich shops and public houses.

4.3.2. Bank Corner

Bank Corner is a result of the development of the Royal Exchange building. Thomas Gresham built the first Royal Exchange building in 1566. It was burnt by fire in 1666, rebuilt and again destroyed in 1838. William Tite designed the present building in 1844, when Bank Corner was incorporated in to the layout of the City. Since its completion, Bank Corner has suffered few modifications, keeping much of its original layout. The last major alteration, the re-design of the existing flowerbeds together with the location of the present seats and access to the underground system, dates back to 1969. At present, the Royal Exchange building is occupied by the London International Financial Futures Exchange. Bank Corner is located at the heart of the City, where many of the most important streets of the City are found: Prince's Street, Threadneedle Street, Cornhill, King William Street, Queen Victoria Street and Cheapside/Poultry (Figs. A and B, Plate 4.2). Bank Corner is highly visible from the surrounding area, only one small segment of its perimeter actually faces a building, The Royal Exchange. This makes the space easily accessible (Fig. C, Plate 4.2). Due to its particular location, Bank Square is very exposed to vehicular movement (in contrast to Abchurchyard) which in this particular location is very congested with cars and buses. There are also two entrances to Bank underground station that open directly onto the public space. Bank Corner faces the Bank of England, a popular tourist attraction in the City.

Bank Corner is a typical example of a very exposed public space. Its shape approximates an elongated triangle. The seats are distributed into two main areas: at the centre of the public space where two rows of seats are placed facing each other, and another group of seats at the bottom of the steps which lead to the entrance of the Royal Exchange building (Fig. C, Plate 4.2). Bank Corner, at street level, can be described as being a hard surface public space, with some decorative elements, which limit pedestrians' routes inside the public space. There are a few small flights of steps in the space to overcome differences in the level of the surrounding streets. There are two statues in commemoration of World Wars I and II at both ends, a sign post indicating the main tourist attractions around the area and some flower beds behind the entrances to the underground station and along its perimeter overlooking the Bank intersection.

There are no wine bars, sandwich shops or any kind of retail outlets facing the public space (Figs. D and E, Plate 4.2). The nearest sandwich shops are located approximately 100 metres away at Royal Exchange Square, another case study.

4.3.3. Exchange Square

Exchange Square is part of the Broadgate office buildings complex, which was built between 1984 and 1991 as part of the redevelopment of Liverpool train and underground station and surrounding area. Exchange Square is located behind Liverpool Street Station (although with no direct access from it) on the north-east side of the City (Fig. A, Plate 4.3). Although Liverpool Street is the main station, Exchange Square is also a short distance from Moorgate, another busy train and underground station for City workers. There are six main access points to the public space, none of them at street level. From the north, access is provided under the canopy of Exchange House Building. From the east, there are three entrances: between Bishopsgate and Exchange Square buildings via a narrow and quite tortuous staircase, via the Great Eastern walk, a foot-bridge that runs along the Bishopsgate building or via Exchange Arcade that links Bishopsgate (road) to the public space. From the west access is from Appold Street via a set of steps. From the south, access is via another set of steps (Figs. B and C, Plate 4.3) at the end of a long footpath that links the public space to the train station.

Exchange Square is the largest public space of the sample, slightly smaller than Trafalgar Square[13]. Its layout is very different from Bank Corner. It is a raised rectangular shaped open space, semi-enclosed with no vehicular movement around it. It is a modern interpretation of the principles set down by Sitte. Not only does the pedestrian encounter a blank façade on the opposite side of every way in, but all the artistic elements are incorporated in the layout: sophisticated façades for the surrounding buildings and sophisticated decorative elements: There is a small water cascade with a pond and a sculpture. There are plenty of trees and a major green lawn, which is used during the summer as a croquet ground. There are plenty of places to sit and the maintenance is impeccable. Exchange Square is well served with catering establishments. There are three wine bars and a sandwich shop that opens directly onto the public space. All the wine bars make extensive use of street furniture, in that tables and seats are provided and heavily used by their customers. The internal

[13] Trafalgar Square's area is approximately 9000 m^2.

route that links Exchange Square to the Exchange Arcade is full of convenience shops, including a newsagent, shoe repair shop and a hairdresser (Fig. C, Plate 4.3).

Due to its size, split-levels and layout, Exchange Square has clearly defined sub-areas inside the public space. It has a central core, which re-creates an "arena" type of space, with tiers of seats overlooking a croquet ground. Surrounding this central core, there are four well-defined areas. To the north, a group of benches aligned facing the Exchange House building surrounded by trees. The remaining three areas are spaces defined by the wine bars and their outside furniture (Figs. C, D and E, Plate 4.3).

4.3.4. Fenchurch Place

Fenchurch Street Train Station was first built in 1841 by London and Blackwall Railway. A new station, designed by George Berkeley was opened in 1854 and last rebuilt in 1935, when Fenchurch Place was incorporated into the City's urban structure, just opposite the train station. The latest development of the public space was in 1987, when new seats and flowerbeds were added. Fenchurch Place is located on the east side of the City (Fig. A, Plate 4.4), but there are no underground stations in the vicinity. The nearest underground stations are Tower Hill, which is a 10-minute walk away to the south, and Aldgate, about the same distance to the north. Fenchurch Place is about 20 metres away from Fenchurch Street, one of the City's main thoroughfares. It can also be reached from the south via a small road called New London Street or from the west via London Street City (Figs. B and C, Plate 4.4).

Fenchurch Place is a hard surface space, all on one level, with plenty of seats and a few trees (Figs. C, D and E, Plate 4.4). There are no physical elements such as small walls or metal fences surrounding the public space. Fenchurch Place, like Bank Corner, is a public space quite open to the surrounding area, with pedestrian and vehicular streets surrounding 3/4 of its perimeter. Although streets open to vehicular movement surround it, the vehicular movement is low and it is mostly limited to taxis that serve the train station or delivery vans that supply local shops. It is common for the surrounding streets during lunchtime and late afternoon to be taken by City workers eating and drinking or relaxing. Out of all the public spaces of the sample, this has the lowest standards of maintenance.

There is one pub and one wine shop facing the public space. Within a short distance, there is also a florist, sandwich shop, newsagent, and a chemist to the south and south-east sides of the public space. Another group of shops is located in New London Street, which makes Fenchurch Place well served with food and small retail outlets. To the north, there is direct access to a major bookshop.

4.3.5. Finsbury Av.

Finsbury Av., like Exchange Square, is also part of the Broadgate office buildings complex, which was built between 1984 and 1991. Finsbury Av. was the first public space to be completed in 1988. It is located to the west side of Liverpool Street Train Station, and is equally far from Finsbury Circus and Finsbury Square, two large green areas in the City (Fig. A, Plate 4.5) as well as Exchange Square. Finsbury Av. is also near to Moorgate train station. There are four main access points to the public space, although all of them are cut off from vehicular movement (Fig. B, Plate 4.5).

Finsbury Av. is the second largest public space of the sample. Although half the size of Exchange Square, both Finsbury Av. and Exchange Square have many morphological similarities. The public space design shows close links to Sitte's ideas of enclosure, since at any entrance the pedestrian faces a building façade on the opposite side. Despite that the "enclosure property", the visual connections to the surroundings are extensive. Although less impressive than Exchange Square, the decorative elements include a small pond and cascade, sculptures, purpose-built seats and charming green areas. Finsbury Av. is a square-shaped open space, virtually at street level, but with a sunken area built in the centre of the space creating two distinctive areas. The centre, which can be reached after going down a few steps, is designed for people to sit and rest, while the surrounding paved area works more like pedestrian streets surrounding this central space (Figs. C, D and E, Plate 4.5). The maintenance, like Exchange Square, is immaculate.

There is only one wine bar facing the public space. No other shops are located in the immediate surrounding buildings. In contrast, to the east side, towards Liverpool Street, there is another public space (Broadgate Circus) which is part of the Broadgate Complex, where plenty of shops and wine bars are accessible. To the west side, there is another small public area named Whitecross Place, which also provides the local City workers with a pub, sandwich shop and newsagent. Unlike Exchange Square, the only wine bar in Finsbury Av. does not provide its customers with any kind of outdoor furniture.

4.3.6. Fleet Place

Fleet Place is located on the original site of one of the quadrants of Ludgate Circus, which was constructed in 1864-69. The site was completely re-developed in 1992, when a new office complex was built with Fleet Place as a central public space. It is located to the west side of the City, relatively near to St. Paul's Cathedral, one of the main tourist attractions in London (Fig. A, Plate 4.6). Fleet Place is located between two entrances to the City Thames train link line, by Holborn Viaduct to the north and Ludgate Hill to the south side. Farrington Street is to the west and Old Bailey to the east. Access from Farrington Street is by way of a steep staircase. From the south, coming from Ludgate Hill, access is through 10 Fleet Place, an office building. The link between Holborn Viaduct to Limeburner Lane or Old Bailey is also not very direct, as pedestrians have to walk around an office building garage entrance to reach their destination (Fig. B, Plate 4.6). The nearest underground stations are St. Paul's to the east and Blackfriars to the south, both approximately 10 minutes walk away.

Fleet Place is a square-shaped, semi-enclosed hard surface space with practically no vehicular movement around the site. To the south side, by 10 Fleet Place, the public space is separated from the building by a vehicular road but it is essentially used by delivery vans. Fleet Place is a raised public space, with steps to overcome the small difference in height between the north and south sides located at specific intervals within the space, suggesting pedestrian routes between the north and south areas. The public space, which is a purpose-built public office space, has a wine bar on its west side, opening directly onto the open space. Wooden benches are provided, and they are placed mainly in the central area, protected by small bushes. There is also a low green wall that separates the wine bar from the rest of the public space (Figs. C, D and E, Plate 4.6). The private maintenance is very good, with a clear upper market clientele.

Although there is only one wine bar facing the public space, Fleet Place is about 50 metres from Ludgate Hill, which has many restaurants, sandwich bars, coffee shops, and pubs.

4.3.7. Love Lane Corner

Love Lane Corner, in the north-west part of the City, is situated at the junction of Love Lane and Aldermanbury road, almost opposite the Guildhall, on the former site of St.

Mary Aldermanbury church. This church was first mentioned in 1181 in historical archives, but was burnt in 1666 during the Great Fire of London. It was rebuilt in 1682 by Christopher Wren, eventually destroyed by bombing in 1940 and never rebuilt. The Corporation of London purchased the site of the existing public space in 1969, when it acquired its present layout. The public space can be approached from three different points: by Love Lane, Aldermanbury and a footbridge that links the Barbican area, over London Wall towards Cheapside (Figs. A and B, Plate 4.7). Love Lane Corner is situated very close to the Barbican Complex and Cheapside, one of the most important shopping streets in the City. The vehicular traffic is not intense in the surrounding streets.

The public space has a square shape, is characterised by being predominantly green, and is divided into three different areas. The first area is surrounded by tall vegetation so that the few seats placed inside are visually detached from the surrounding road. There is a second green area, mainly covered with grass and some trees, which includes the area of the destroyed church, but with no proper seats available and on a slightly lower level compared to the rest of the public space. The third area has a "L" shape format and it is mainly a hard surface area. The majority of wooden seats are located in this area (Figs. C, D and E, Plate 4.7). Due to the space's location at the junction of two roads, the public space is very visible from the surrounding streets. Of its four sides, two of them face buildings and two face the surrounding roads. There are no special decorative elements, apart from an information sign with the history of the site. For the area, Love Lane Corner is not a large place compared to other cases in the sample, being very similar in size to Fenchurch Place.

There are no wine bars or sandwich shops facing the public space or in the immediate surrounding area. The nearest sandwich shop is located around 100 metres away towards Cheapside.

4.3.8. New Change/Cheapside Corner

New Change/Cheapside Corner was built during the 1950's, when an office building behind it was completed. New Change/Cheapside Corner is located in the west part of the City, between Fleet Place and Bank Corner (Fig. A, Plate 4.8). It is a modern space at street level, at the junction between New Change and Cheapside, two important road arteries in the City of London. It is very close to St. Paul's Cathedral, almost overlooking the gardens at the back of the cathedral. There are only two access points to the public space. The first one is from the pedestrian street between the public space and the major building behind it, where a wine bar is situated. The second one is by a zebra crossing on New Change that links the public space to the back of St. Paul's Cathedral gardens (Figs. B and C, Plate 4.8).

This public space is the smallest of all the selected cases. New Change/Cheapside Corner is a hard surface space with a semi-circular shape and some variety of street furniture. Seats are spread almost everywhere inside the public space, with wooden seats backing onto New Change and Cheapside. Facing the wine bar, are tables and chairs (Fig. C, Plate 4.8). There are no decorative elements, although there is some vegetation surrounding the space which creates a partial visual shield against the neighbouring traffic (Figs. D and E, Plate 8). The public space is slightly below street level (50 cm), and is surrounded by busy vehicular traffic roads. None of its sides face a building. Due to its particular location, situated at the junction of many streets, the isovists are very extensive and diverse. It overlooks all of Cheapside, New Change, part of Newgate Street and Foster Lane, from where it is possible to see St. Anne/St. Agnes churchyard, another selected public space (Section 4.3.11). It is reasonably well maintained.

In addition to the one wine bar facing the public space, along nearby Cheapside a full range of commercial outlets is provided, from sandwich shops to male and female clothes retail shops.

4.3.9. North Guildhall

North Guildhall is located to the west side of the City of London, overlooking Love Lane Corner, at the back of the building that houses the Corporation of London and the Guildhall Library (Fig. A, Plate 4.9). Like Love Lane Corner, it is situated between the London Wall and Cheapside, where Moorgate and Bank are the two nearest underground stations, both about ten minutes walk from the public space. North Guildhall can be approached either by Aldermanbury from the west or Basinghall Street from the east. It can also be reached from a footbridge that links the Barbican to the south side of London Wall (Figs. B and C, Plate 4.9). The public space was built in 1966, when the Corporation of London building was redeveloped.

North Guildhall is a modern office development space above street level. It is a hard surface public space, semi-enclosed, divided into two levels, which together comprise its "L" shaped form, and separates the space into two distinctive areas. The larger area is where most of the street furniture is concentrated. There are concrete benches along the south and east sides, close to the façades of the surrounding buildings. There is also a tier of seats by the footbridge that overlooks the back entrance of the Corporation of London. There is a sculpture but no vegetation of any sort. Moving west, going down a few steps (the difference in level between the two areas is small, approximately 50 centimetres) there is a small fountain but no seats or vegetation of any kind (Figs. C, D and E, Plate 4.9). The upper level also has a gate that opens into a very narrow space which connects to one of the entrances of the Chartered Insurance building, which is at the lower level. Although open to the public, this connection is used specifically as an entry point for people who work in this building. The public space is generally well maintained, and it is used during the summer for lunchtime recreational activities as a basketball court is assembled on the upper level of the public space. It is a relatively large space compared to the other cases but with one of the smallest visibility ratios of the sample.

Like Love Lane Corner, there are no wine bars or sandwich shops facing the public space or in the immediate surrounding area. The nearest sandwich shop is located around 100 metres away in Gresham Street, which has a small string of shops near the Guildhall.

4.3.10. Royal Exchange

Royal Exchange Square is also a result of the development of the Royal Exchange building, completed in 1844. It is located at the back of the Royal Exchange building, between the Royal Exchange and the building that hosts the Bayerische Vereinsbank. Royal Exchange is located at the heart of the City, less than one hundred metres away from Bank Corner (Fig. A, Plate 4.10). It is located between Cornhill and the junction of Threadneedle Street and Old Broad Street, all very busy roads with high levels of both pedestrian and vehicular movement. Since its completion, Royal Exchange Square has not suffered any significant redevelopment, apart from the introduction of wooden seats and tables used by the wine bar facing the space. The public space can be accessed from three different directions: from Threadneedle Street to the north, from Cornhill to the south or Royal Exchange Av., a narrow pedestrian road to the east (Fig. B, Plate 4.10). Bank is the nearest underground station. It is also close to the Bank of England and Lloyd's Insurance building, both popular tourist attractions in the City.

Royal Exchange is a long and narrow hard surface space, at street level. Despite its being surrounded by busy roads, due to its shape, Royal Exchange is not particularly exposed to the surrounding vehicular movement. There are some decorative elements. There are four statues, two of them also incorporating a fountain and one surrounded by purpose-built seats. There are benches located along the space, in addition to the tables and seats provided by the only wine bar facing Royal Exchange. There is some vegetation along the public space with trees and flowerbeds by the buildings façades (Figs. C, D and E, Plate 4.10). It is a smart, well-maintained space and very popular among well-off City workers who share a taste for drinking Champagne at lunchtime. It is a medium-sized public space compared to the others included in the sample, but with extensive isovist along Threadneedle, Old Broad Street and Cornhill.

In addition to the wine bar, there are two sandwich shops and two stationery shops facing the public space. Along both Threadneedle Street and Cornhill, there are sophisticated retail establishments with shops such as Hermès, Louis Vuitton and Loewe, clearly aimed at an upper-class market.

4.3.11. St. Anne & St. Agnes churchyard

The present site of St. Anne & St. Agnes churchyard was originally the burial ground attached to St. Anne & St. Agnes church. It was destroyed in 1548 and 1666 by fire, but rebuilt by Christopher Wren in 1681. The site was taken over by the Corporation of London in 1967, and it has been unchanged as far as the spatial layout is concerned ever since. Similar to Love Lane Corner, the public space has two of its sides surrounded by buildings and two sides open to the surrounding streets. St. Anne & St. Agnes churchyard is situated at the junction of Noble and Gresham Street, close to St. Martins Le Grand, London Wall and Cheapside, all very important, well connected streets of the City. There is almost free access from Noble and Gresham Street to the public space since there are no rails or physical barriers of any kind between the public space and the surrounding streets (Fig. B, Plate 4.11), and vehicular traffic is light and is limited to cars and vans. St. Anne & St. Agnes churchyard is located 200 metres away from Love Lane Corner to the east and the same distance from New Change/Cheapside Corner to the south (Fig. A, Plate 4.11).

St. Anne & St. Agnes churchyard is a "L" shaped public space and it is divided in three distinctive areas. Like Love Lane Corner, it is predominantly green. One area is partially surrounded by high vegetation and has a small wall that creates a barrier between this area and surrounding streets. It is covered in grass and there is only one wooden seat available. The second area, right at the junction of Noble and Gresham Street, is essentially a hard surface area. There are some wooden seats and a small flowerbed at the centre. The third area is a long and rectangular space, with a green lawn area at the back and with wooden seats overlooking Noble Street, with its back to St. Anne & St Agnes church but protected by dense vegetation. From the back of this lawn, there is a hidden entry to the backyard of St. Anne & St. Agnes church, which effectively is not accessible by the public. There are no decorative elements such as fountains or statues (Figs. C, D and E, Plate 4.11).

There are no shops in the vicinity. The nearest food outlets are to be found in Cheapside, which is around 200 metres away.

4.3.12. Whittington Gardens

This site was the burial ground of St. Michael Paternoster Royal Church. St. Michael's church which dates back to the XIII Century. The church was first rebuilt in the XV Century by Sir R. Whittington. It was later destroyed in 1666 in the Great Fire of London and eventually rebuilt in 1678 by E. Strong under the supervision of Sir Christopher Wren. The Corporation of London acquired the site in 1953; the present garden was laid in 1960 and was modified in 1969 when the enlargement of Upper Thames Street took place. Whittington Gardens is in the south area of the City of London, about 200 metres from the River Thames, although access to the river is not straightforward due to a difficult pedestrian crossing over Thames Street (Fig. A, Plate 4.12). The public space itself is reasonably near to the London International Finance building and Cannon Street, a busy commercial road. It is also very close to Cannon Street train station, about 250 metres to the north-east side of the public space. The public space to the south faces the very busy Upper Thames Street with continuous heavy traffic, which includes lorries and other heavy vehicles throughout the day. Conversely, to the north, the public space faces the quiet College Street, which actually separates the former churchyard from its original church. To the west, the open space is surrounded by buildings whereas to the east, there is a pedestrian road that links Upper Thames to College Street, which is busy with pedestrian traffic that comes from the south of the river, mainly via Southwark bridge towards Cannon Street south (Fig. B, Plate 4.12).

The public space has a rectangular shape and it is at street level. It is divided into two distinctive areas. The first is a small green area, quite separated from the main body by a shrubbery wall and low metal fence. The main body is characterised by a hard surface floor where all the available seats in the public space are located. As far as the street furniture is concerned, the public space is not sophisticated. The only decorative element is a fountain located at the centre. A low brick wall divides Whittington Gardens from College Street with some low-level vegetation, and between the public space and Upper Thames there is a flower bed with dense vegetation that creates a semi-permeable barrier between the two areas (Figs. C, D and E, Plate 4.12).

Almost opposite the public space there is a sandwich shop and a public house. Not far, along Cannon Street, there is a full range of commercial establishments including sandwich shops, pubs, newsagents, fashion, chemists, banks, etc.

4.4. METHODOLOGY

4.4.1. DEFINING AND REPRESENTING THE PUBLIC SPACE

In Chapter 3, to overcome the difficulties of defining the spatial boundaries of traditional urban squares, the convex representation was adopted. The convex representation was used as a "device" to study morphological characteristics of urban squares. As a comparative measure between traditional urban squares and in-use public spaces in the City of London, it was felt necessary to keep the same representation. However, although essential as a comparative measure, the convex representation will not be truly representative of the spatial boundaries of public spaces as areas for static activities, as it incorporates areas (roads) designated for vehicular movement. Thus, it is proposed to study the public spaces in the City of London through two models of representation – the "convex container" and the "effective space" – which are defined next.

4.4.1.1. The convex container definition

For the "convex container", the spatial boundary of each public space is defined by the biggest convex space with regards to its physical area that could be inserted into the open space, limited by the façades of the buildings but omitting elements such as pavements, differences in street level, vegetation, etc[14]. Consequently, the spatial area of the convex container specifies the largest and most compact spatial area of the public space. This is a purely theoretical approach, since, in real terms, the activities related to the convex container do not provide the sole "function" of public spaces, where people come for unprogrammed static activities. It may also incorporate areas used for vehicular (roads) and pedestrian movement (pavement). Plate 4.13 illustrates the convex container element which defines the open spaces for the twelve selected cases, including the convex and axial break-ups.

4.4.1.2. The effective space definition

The second approach looks at the open spaces in terms of the area of each public space that is effectively used by the public for informal static activities. This "effective space" is the result of combining the recognised open space with any adjacent areas that are informally incorporated by the public for static activities. In some cases it included steps of neighbouring buildings as in the case of Bank Corner (steps of the Royal Exchange building). In other cases, it included the adjacent pavement, as is the case for Fenchurch Place[15]. In this approach the convexity property used before is no longer the rule but the exception. From the twelve selected public spaces, only in three cases, Bank Corner, Fenchurch Place and New Change/Cheapside Corner, can their effective area be spatially defined as one single convex element. Consequently, in this second form of representation, the effective space describes the two-dimensional spatial entity as dictated by its social function, that is, a convex break-up of spatial

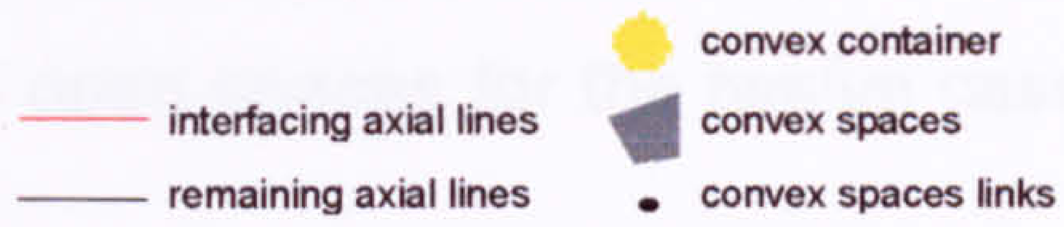
---

[14] The convex container follows exactly the same definition as the "main convex element" of traditional squares of Chapter 3. A different terminology was adopted in this chapter to avoid confusion as to which sample the analysis is referring to. The "main convex element" refers to the sample of traditional squares and the "convex container" refers to the City of London sample.

[15] Why some areas are incorporated and others are not is open to interpretation, but the micro detail of public spaces may become important at this stage. It could also be associated with insufficient facilities within the open space. In Bank Corner, the provided seats in peak hours may be insufficient for the users and the steps of the Royal Exchange Building due to its ergonometric qualities are easily incorporated as seating places. In Fenchurch Place, the pavement at the south side (refer to Figs. C and D, Plate 4.4, Appendix 2) is effectively used, primarily by people drinking from the neighbouring pub. The fact that Fenchurch Place and the pavement surrounding it are at the same level on the same material, thereby creating a non-existence partition of what is designated mainly for moving people (pavement) or static people (public space), might encourage people to claim the adjacent areas. Another factor that might be related is the relatively small amount of moving people on this pavement, although at this stage it is difficult to establish if the amount of moving people is small because of the high number of static people or the opposite.

Plate 4.13. Convex container representation showing convex break-up and axial lines

scale: 1:3500



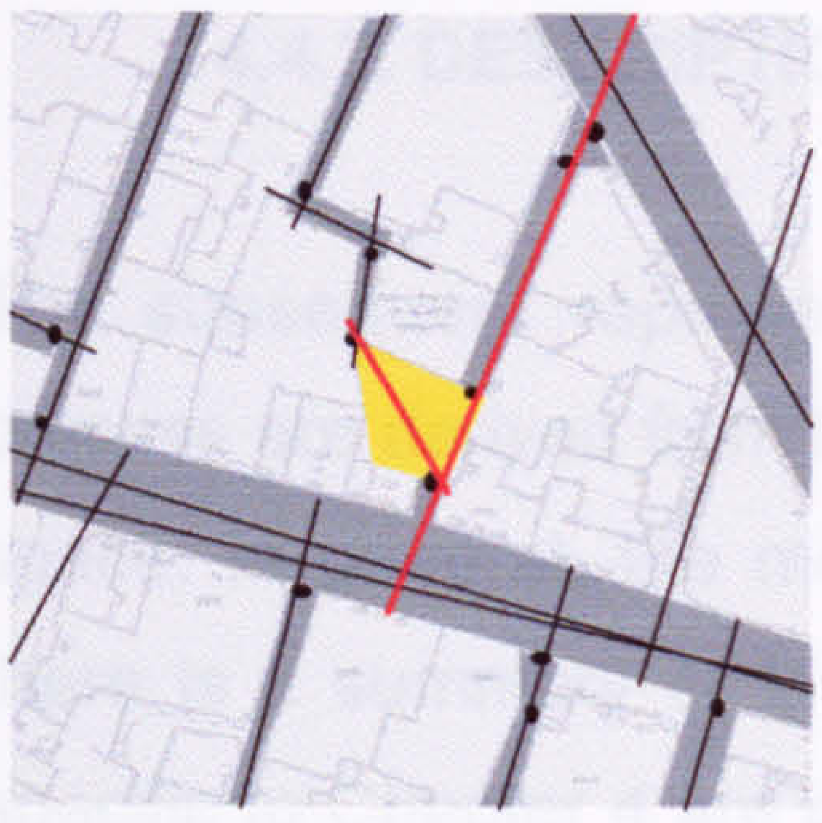


Fig. 1. Abchurchyard

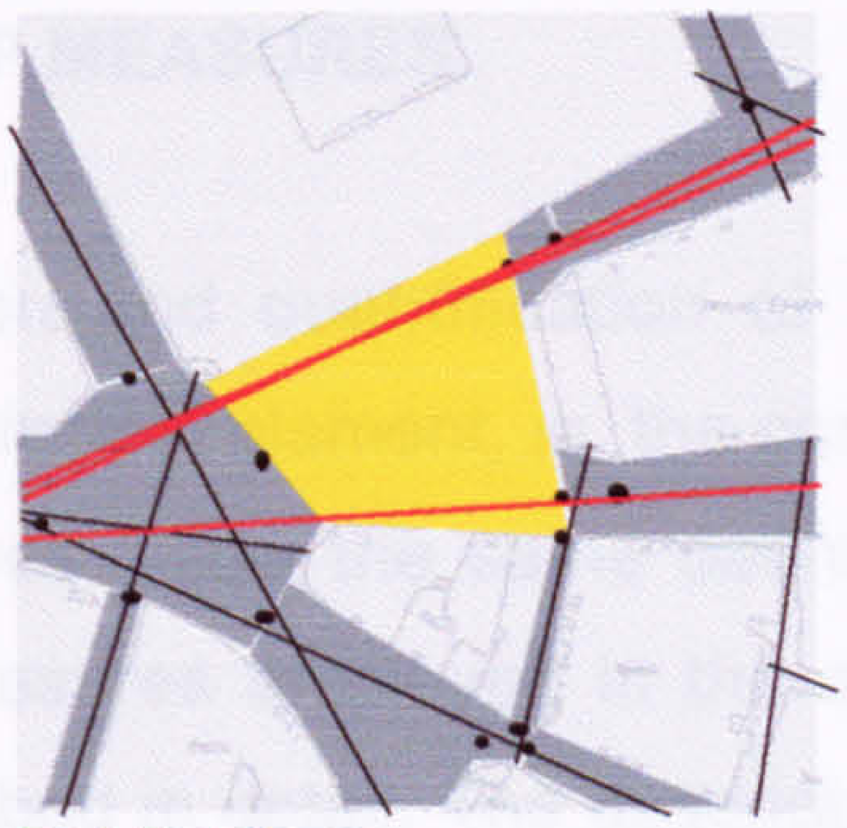


Fig. 2. Bank Corner

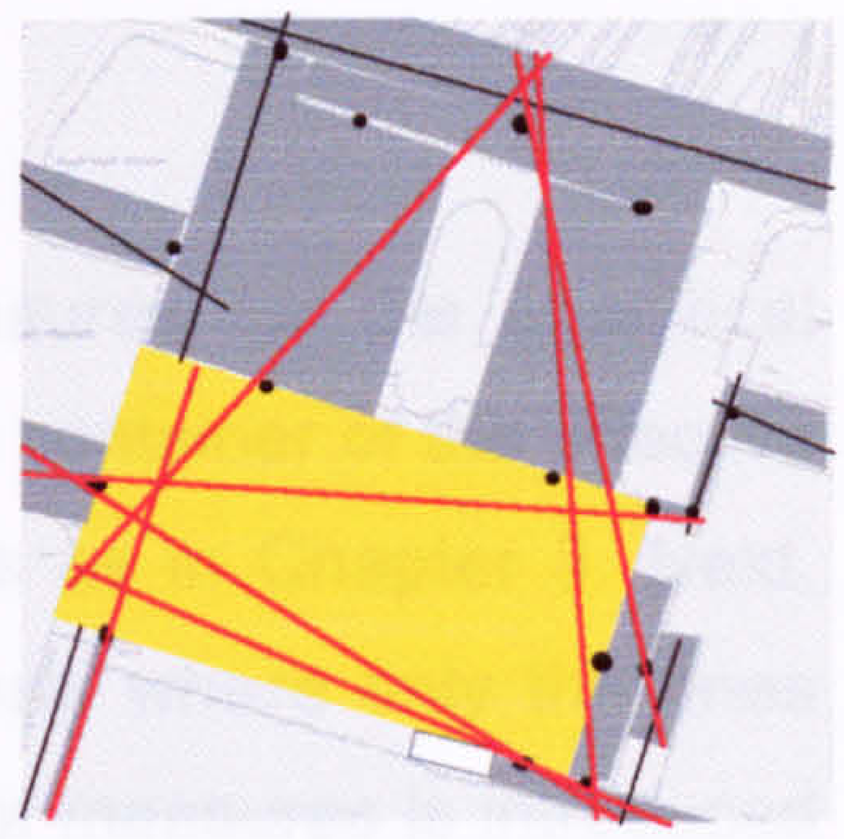


Fig. 3. Exchange Square

Fig. 4. Fenchurch Place

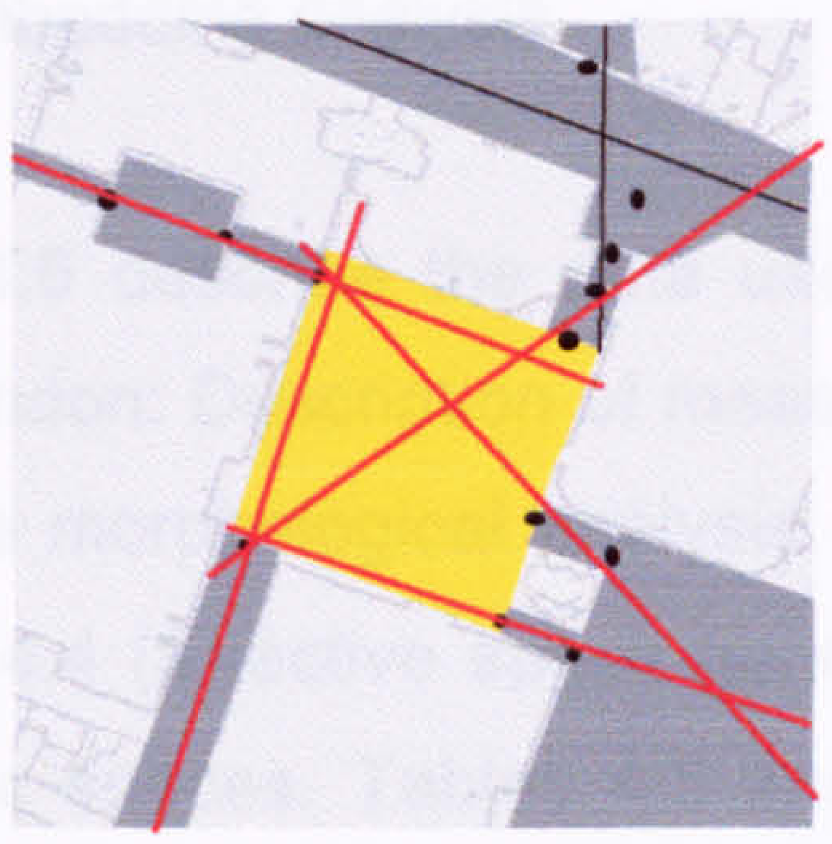


Fig. 5. Finsbury Av.

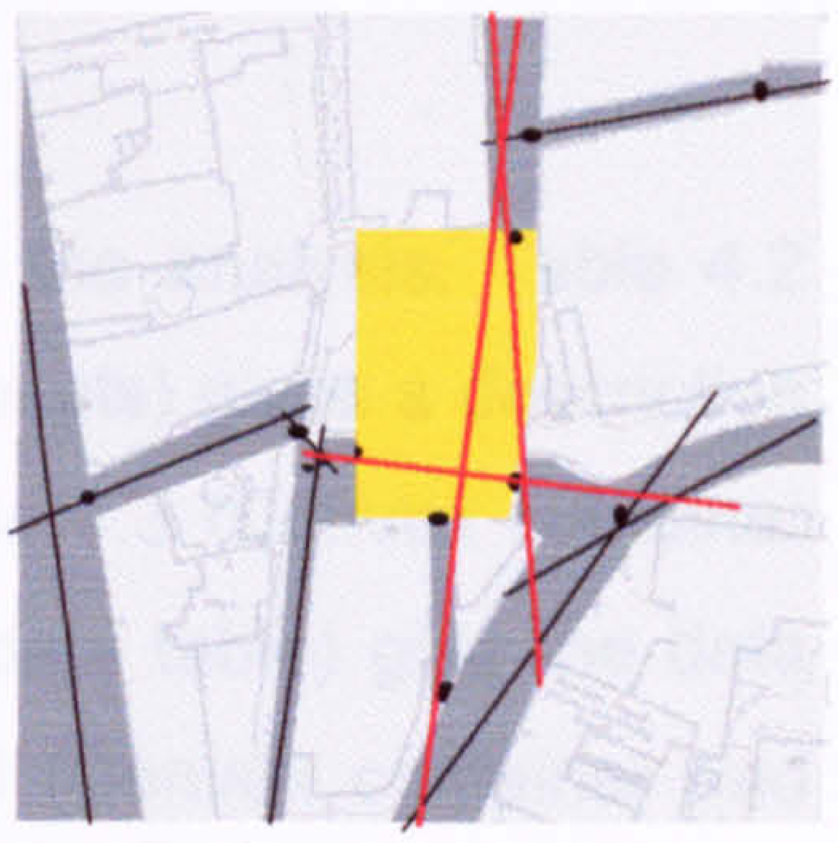


Fig. 6. Fleet Place

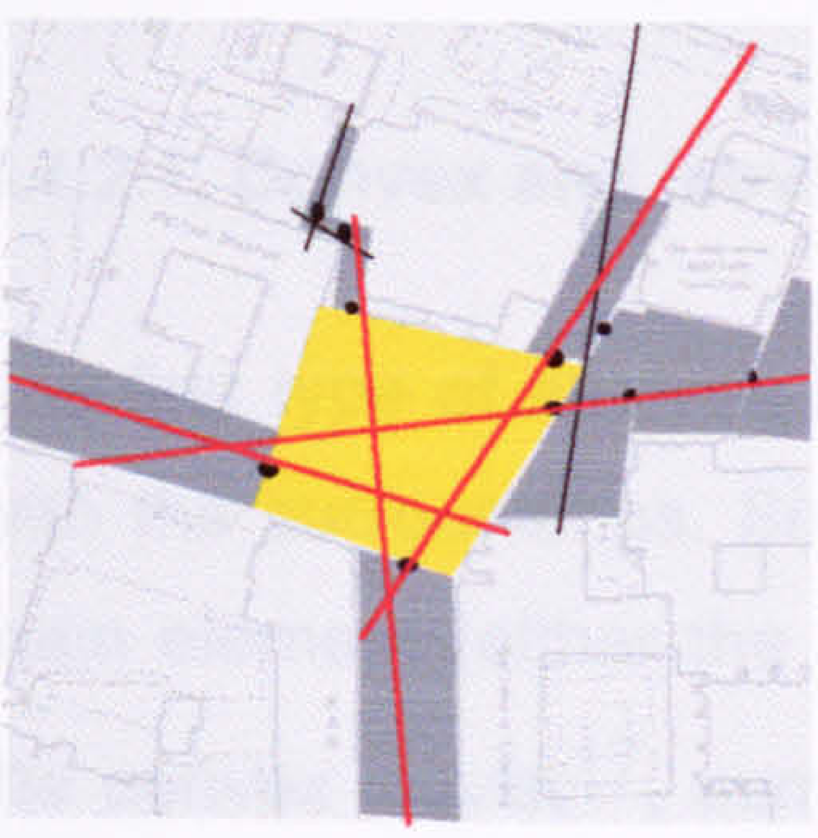


Fig. 7. Love Lane Corner

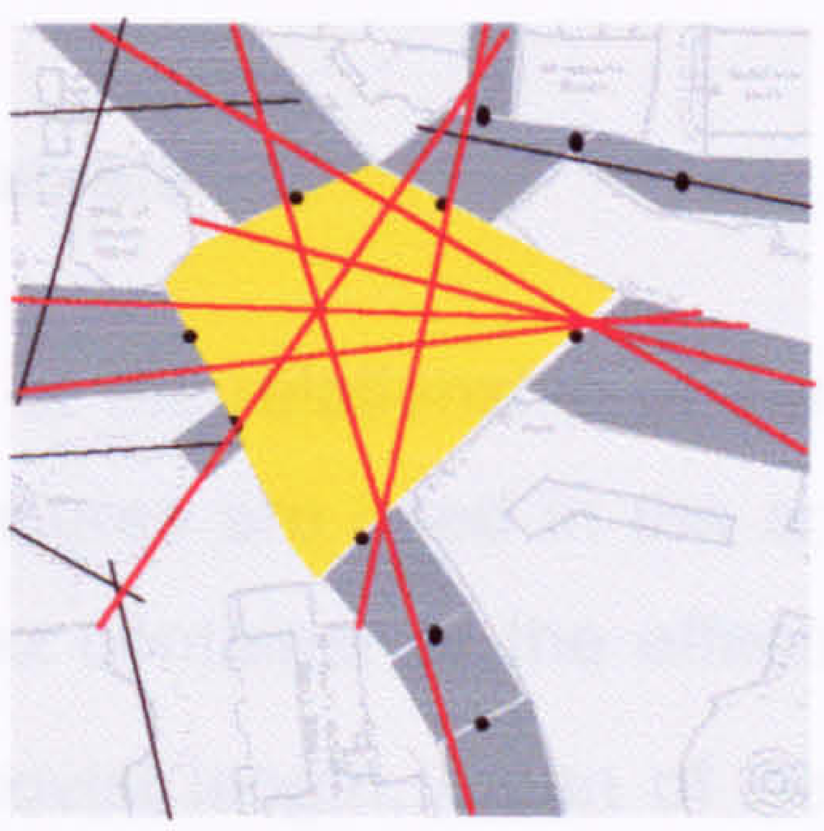


Fig. 8. New Change/Cheapside Corner

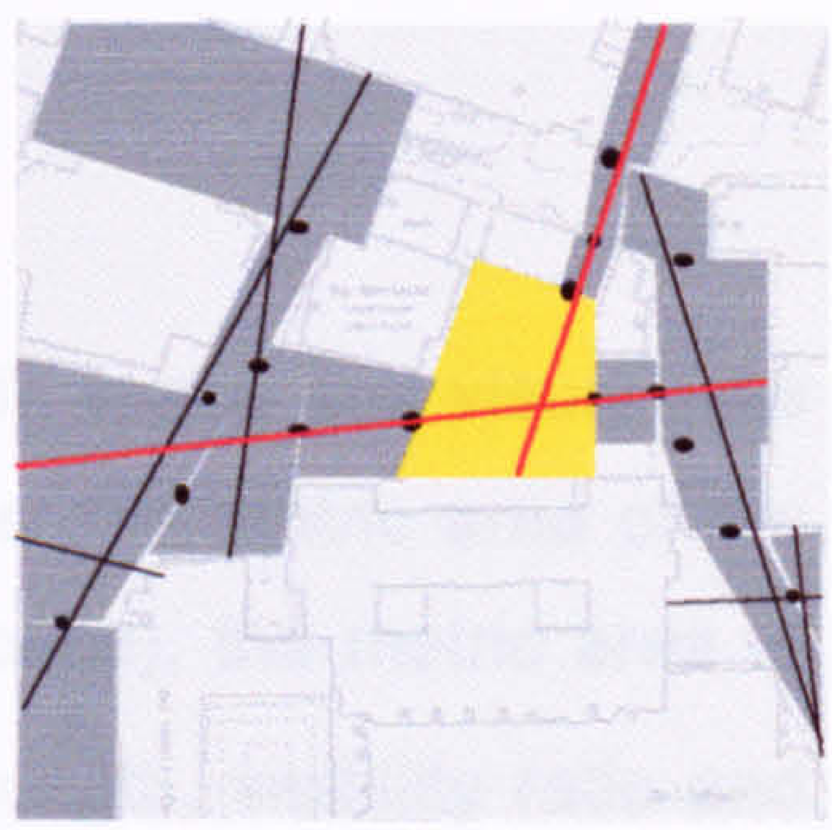


Fig. 9. North Guildhall

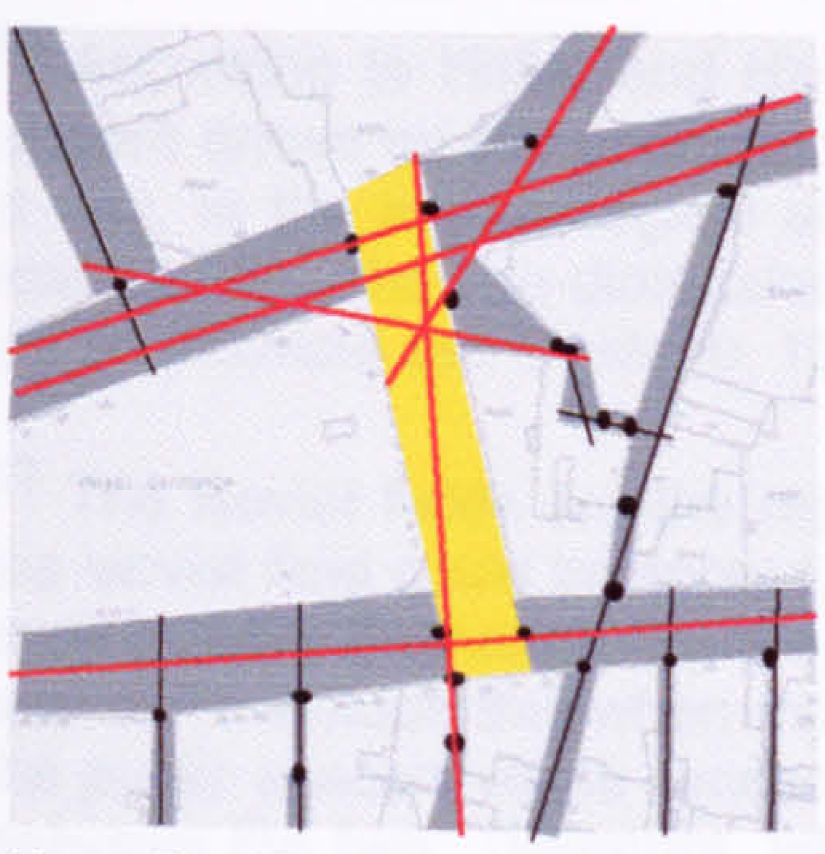


Fig. 10. Royal Exchange

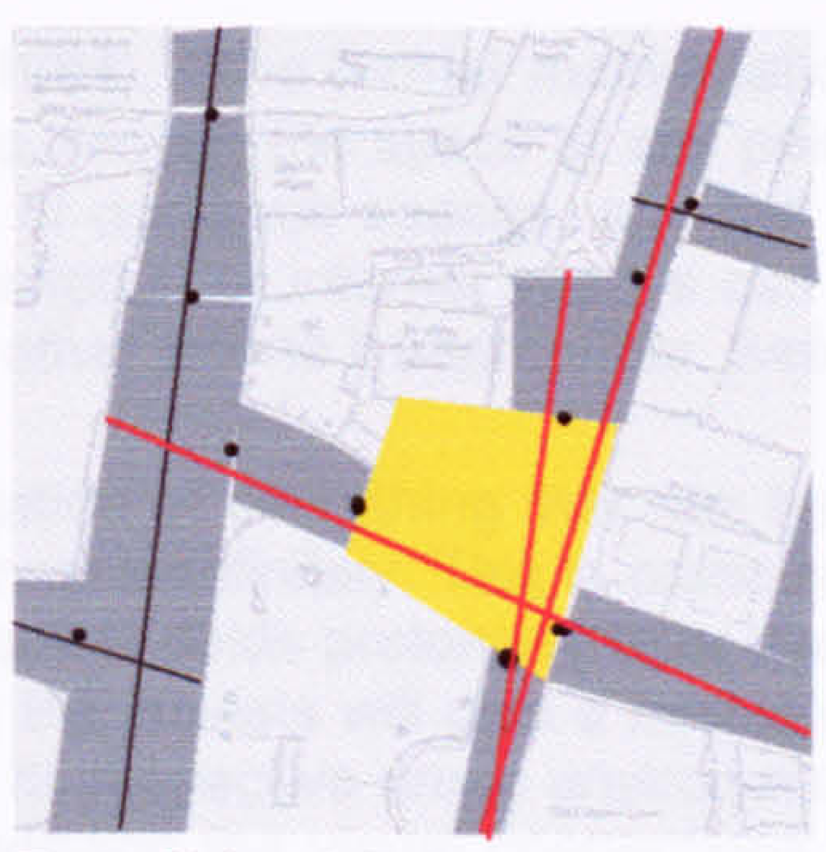


Fig. 11. St. Anne & St. Agnes churchyard

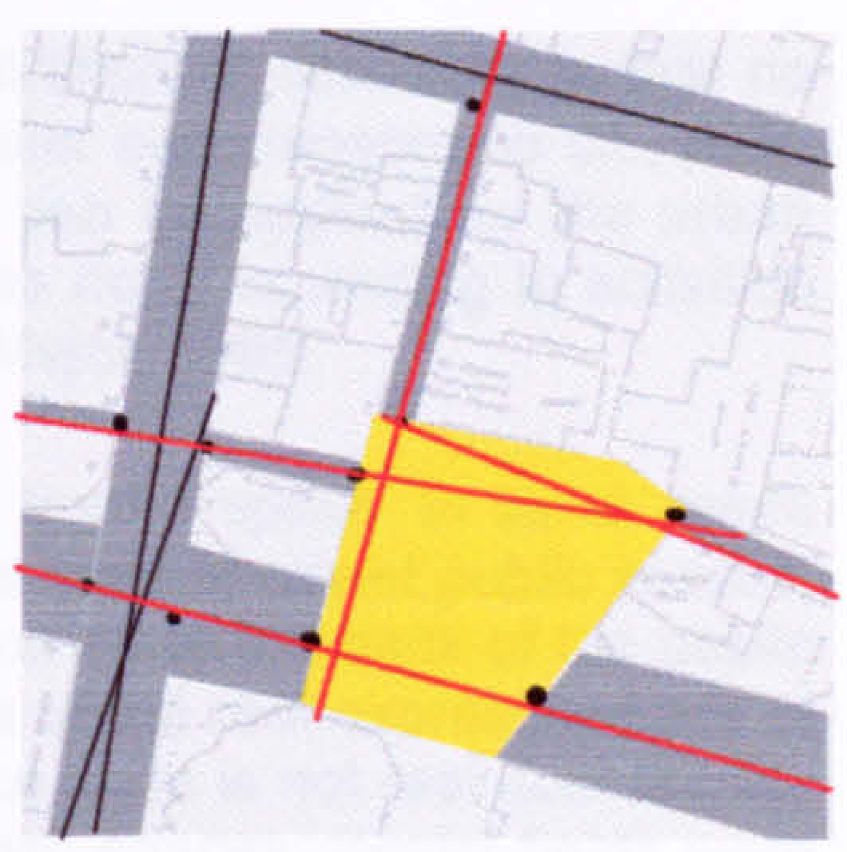


Fig. 12. Whittington Gardens

activities, rather than as according to the mathematical definition of convexity[16]. Plate 4.14 illustrates the effective element that defines the open spaces for the twelve cases including the convex and axial break-ups.

4.4.2. DESCRIPTION OF MEASURES

The subsequent representation and quantification of measures for the analytical process are derived from the principal element, ie, the convex container of the effective space. In general, the measures follow the same definitions as in Chapter 3. Next, there is a summary of the measures employed in the analysis where only the ones specific to Chapter 4 are described in detail. The description of measures is introduced according to the three types of analysis, that is, the convex and isovist analysis, the interfacing axial lines and the embedding analysis.

In appendix 2, Tables 4.2 to 4.6 describe the data used *in the analysis. Table* 4.2 (Public spaces in the City of London: Description of measurements) gives a description of all the measures used in the morphological analysis. Table 4.3 (Convex container general data table) and Table 4.4 (Effective space general data table) give the data compiled for each of the public spaces. Tables 4.5 and 4.6 (Convex container and Effective space correlation matrixes) give an initial picture of how the measurements used in the morphological analysis correlate with each other.

4.4.2.1. Convex and isovist analysis

The first type of analysis looks at the relationship of the public space and visual links with the surroundings. Six measures are used in the analysis: the metric area of the main element (either the convex container or the effective space), the metric area of the convex isovist[17], sum of isovist length, mean of isovist length, visibility ratio and enclosure ratio.

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[16] According to Hillier and Hanson (1984), "The formal mathematical definition of convexity is that no tangent drawn on the perimeter passes through the space at any point" (Hillier and Hanson, op cit., p97). In fact, in the morphological analysis of domestic spaces, and the same can be applied for the urban environment, the two-dimensional description of internal spaces can also be done according to activities (as an example see Monteiro, 1997) or other criteria if appropriate. See also Major, 1998.

[17] The isovist fields are the representation of everything that can be seen from a space. In some cases the isovist field could be spread out almost indefinitely. This is particularly the case of raised public spaces, most notably Exchange Square, with isovist fields prolonged over the horizon as at the back of the public space. To include this when modelling the isovists will give a mistaken idea of the real expressiveness of the public space's visual connection to its respective urban environment since there is not real accessibility between the two. Therefore, while modelling the visual connections of public spaces, isovist fields were limited only to areas where there is direct access.

Plate 4.14. Effective space representation showing convex break-up and axial lines

scale: 1:3500

effective space
interfacing axial lines
convex spaces
remaining axial lines
convex spaces links

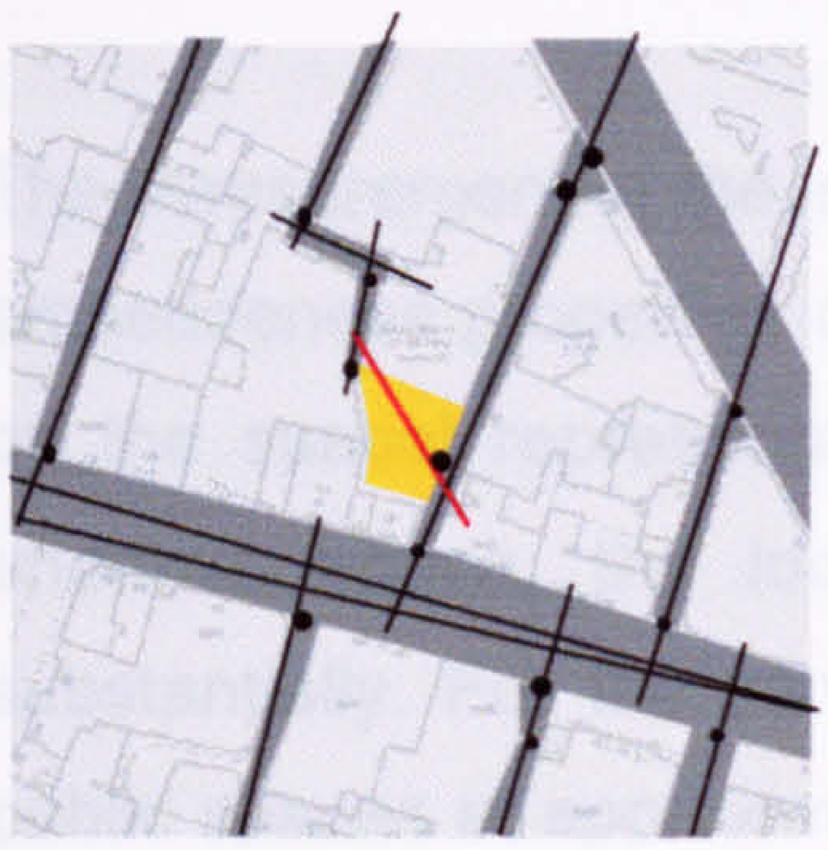

Fig. 1. Abchurchyard

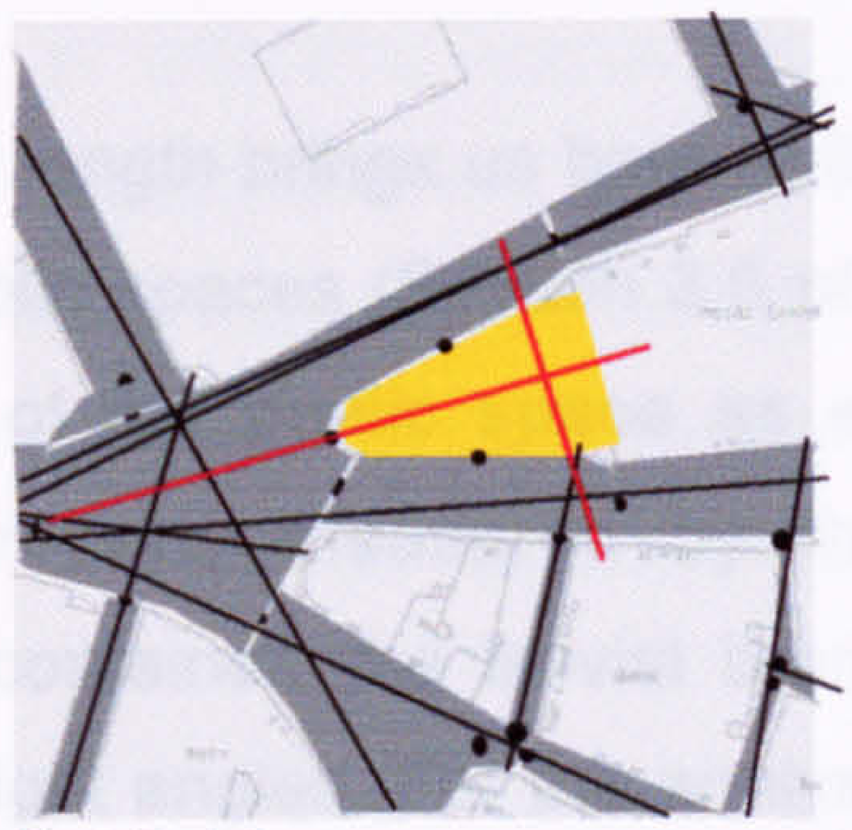

Fig. 2. Bank Corner

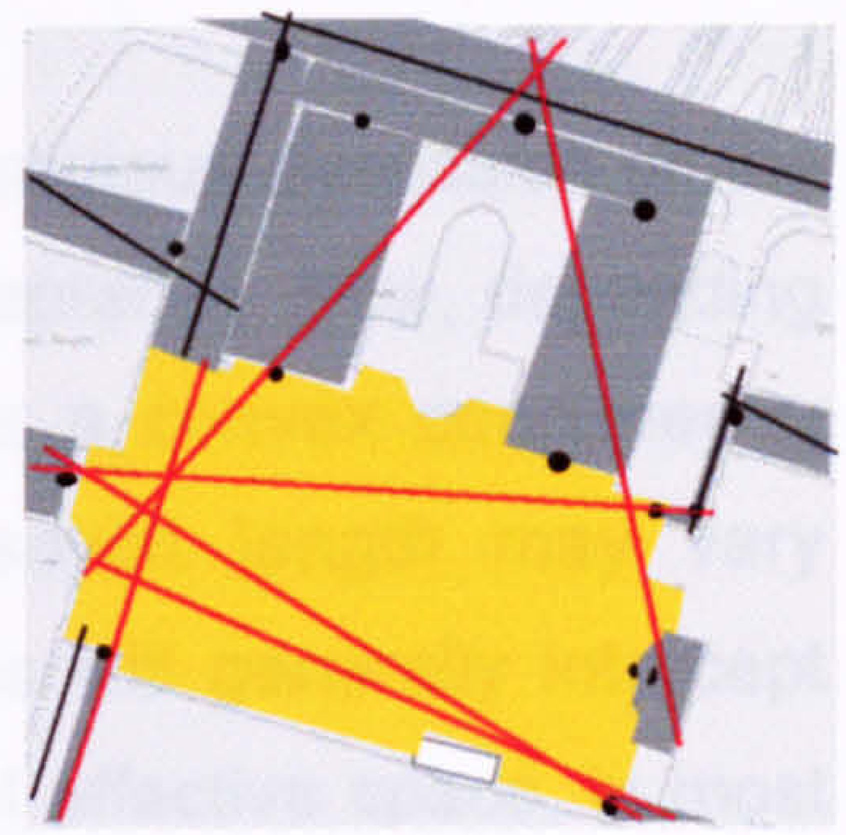

Fig. 3. Exchange Square

Fig. 4. Fenchurch Place

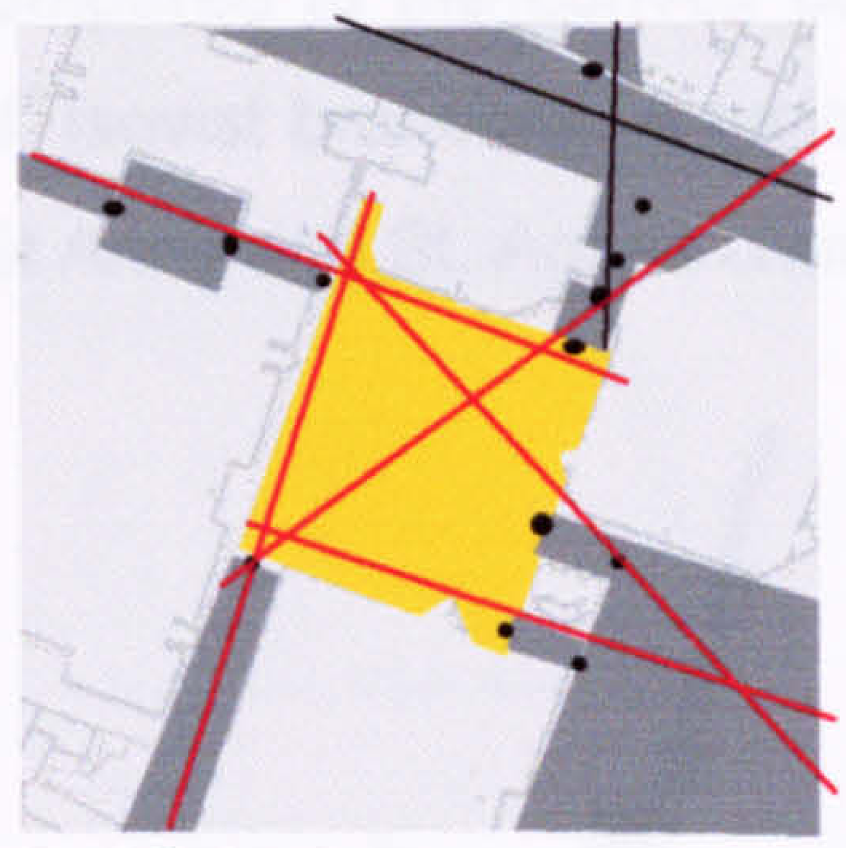

Fig. 5. Finsbury Av.

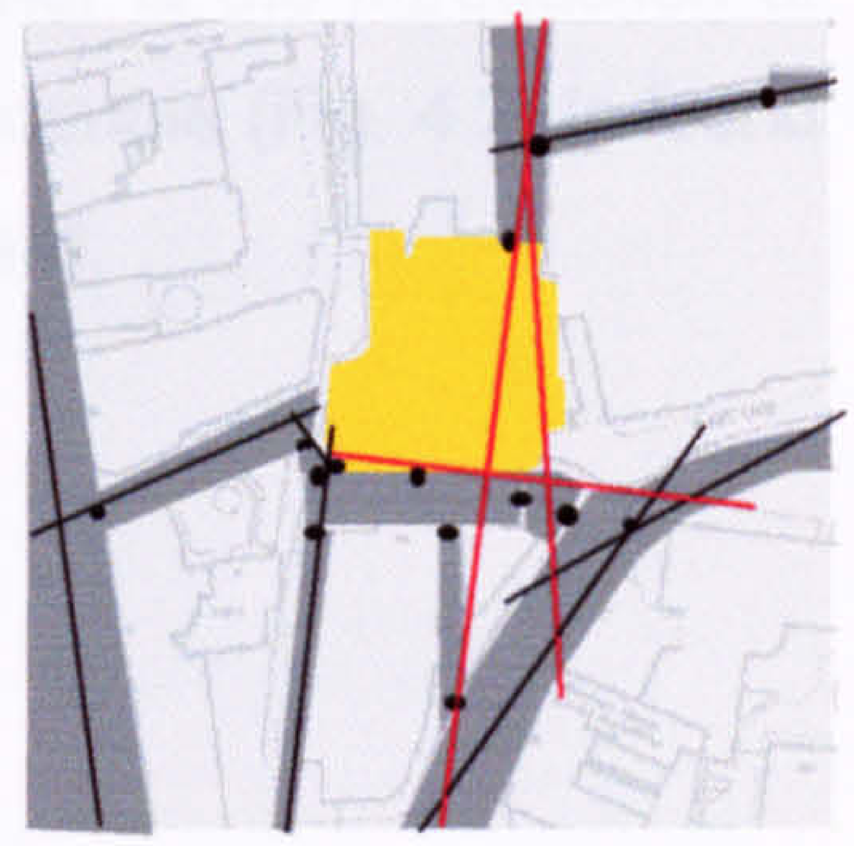

Fig. 6. Fleet Place

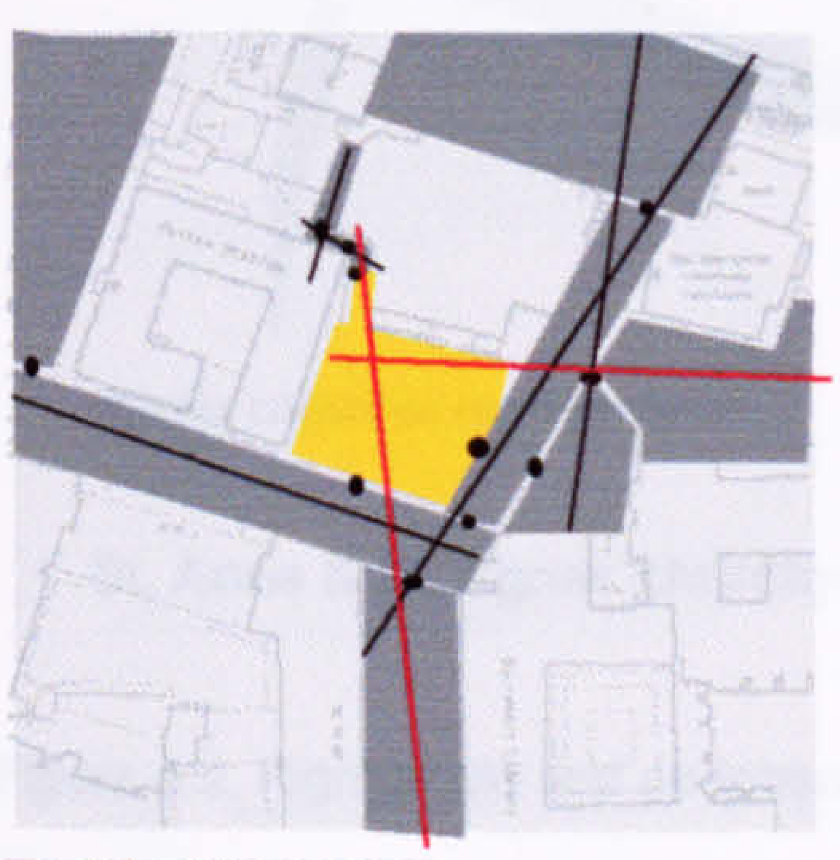

Fig. 7. Love Lane Corner

Fig. 8. New Change/Cheapside Corner

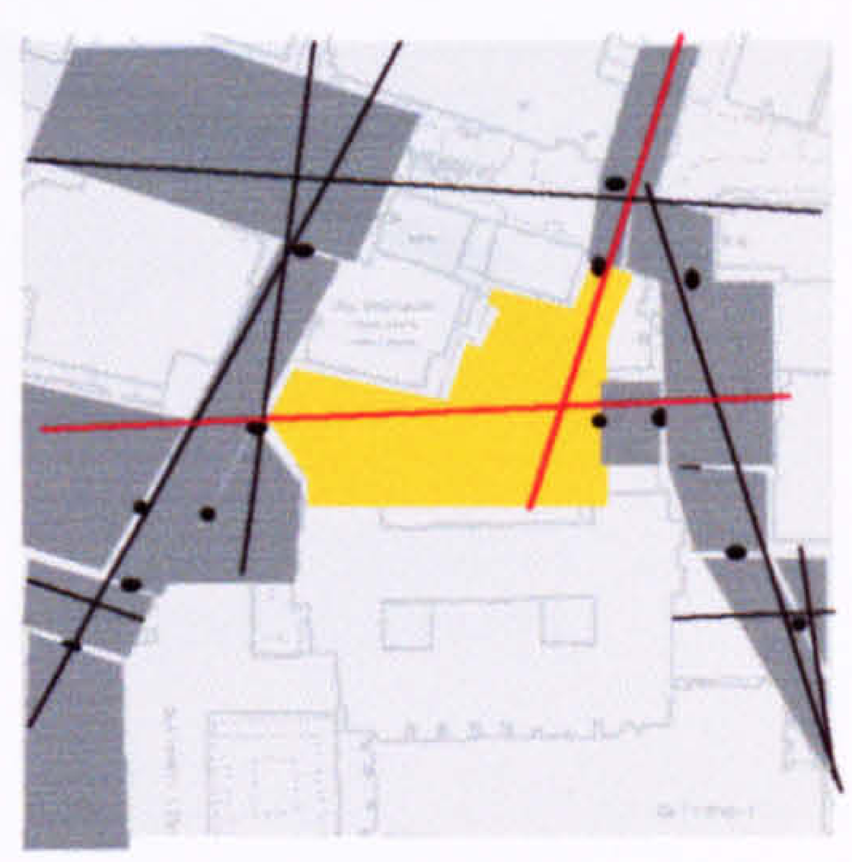

Fig. 9. North Guildhall

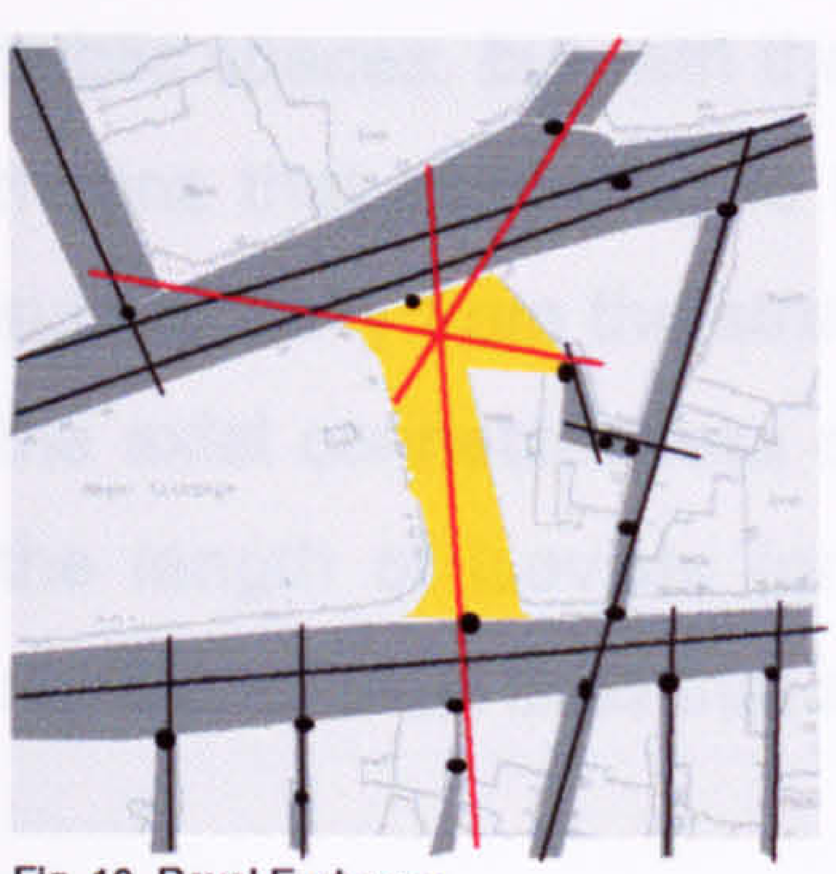

Fig. 10. Royal Exchange

Fig. 11. St. Anne & St. Agnes churchyard

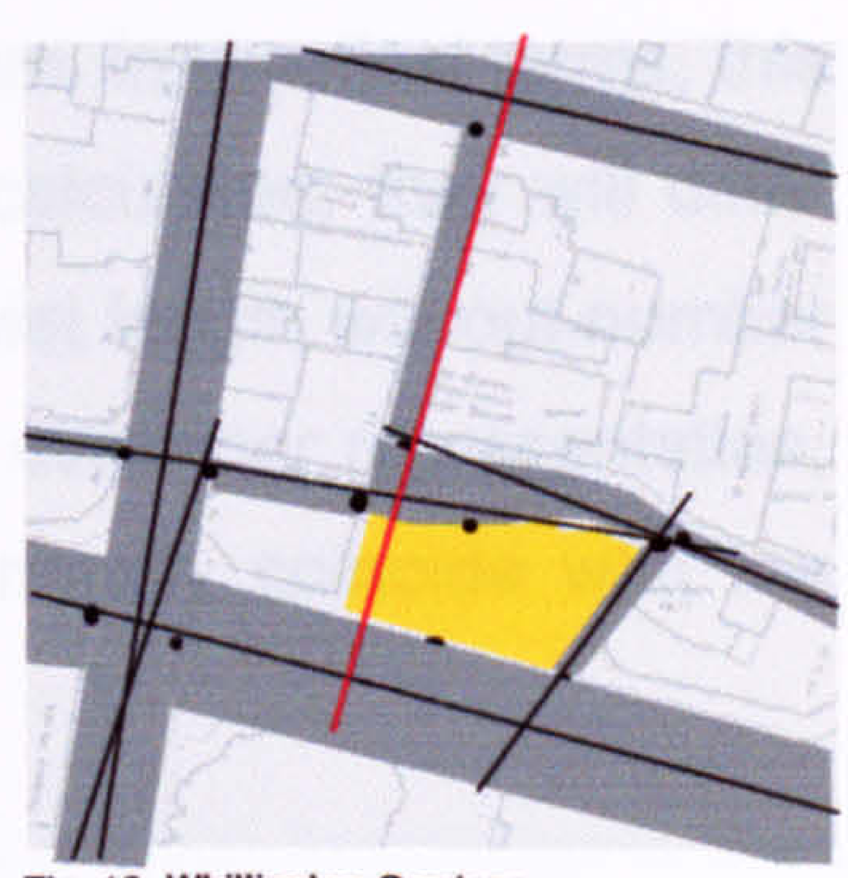

Fig. 12. Whittington Gardens

The convex isovist is the one visible from within the convex container or effective space. The visibility ratio is defined by the area of the convex isovist divided by the area of convex container or effective space. The enclosure ratio is the ratio between unbuilt and built perimeter.

The measurement of the isovist length brings us back to the previous discussion on the embeddeness properties of public spaces (Section 3.5 of Chapter 3). Now, depending on the spatial representation of the public space as either a convex container or effective space, the local property measured by the isovist length may vary substantially. For the convex container, the isovist branches will generally intercept public spaces at approximate right angles. For the analysis of effective space, in most cases the representation of public spaces is done with more than one convex space. The most significant change compared to the convex container is the introduction of what could be called "peripheral" isovist branches. A typical example (Fig. 4.2) is found when comparing the isovist for St Anne and St. Agnes churchyard.

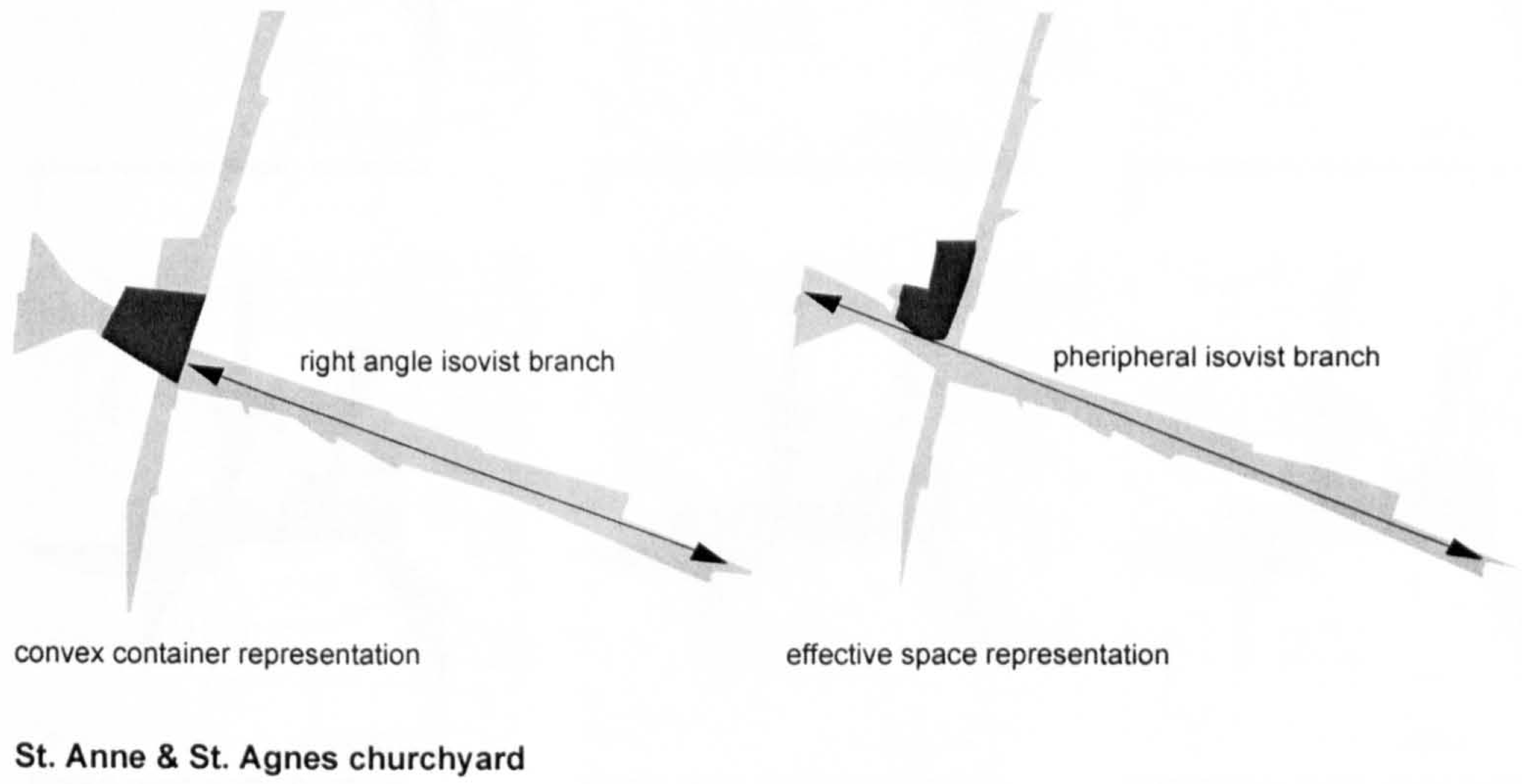

Figure 4.2. Right angle and peripheral isovist branches

This peripheral branch of the isovist does not overlap with axial lines interfacing with public spaces, but with the axial lines that are adjacent to them. In practical terms, this means that according to the way the length of isovists are calculated, they will differ substantially from the strategic value, as the branches of isovist length will out-number the axial connectedness of the public space. For the convex container representation, the length of isovists (or the number of branches) will generally coincide with the number of axial lines that interface with the public space.

The isovist lengths were quantified using three different experimental methods. The first method, denominated "isovist total", comprises the length of the isovist for all vertices of the isovist branches[18] (Figs. 4.3(1) and (4)). The second method, called the "isovist selected", analysed the branches of isovist that had axial lines crossing the body of the convex container or effective space (Figs. 4.3(2) and (5)). The third method, called "isovist special", analysed the isovist length considering only major segments of the isovist branches (Figs. 4.3(3) and (6)). Figure 4.3 shows the three methods for measuring isovists using North Guildhall as an example. Plates 4.15 and 4.16 show the convex isovist for both convex container and effective space samples.

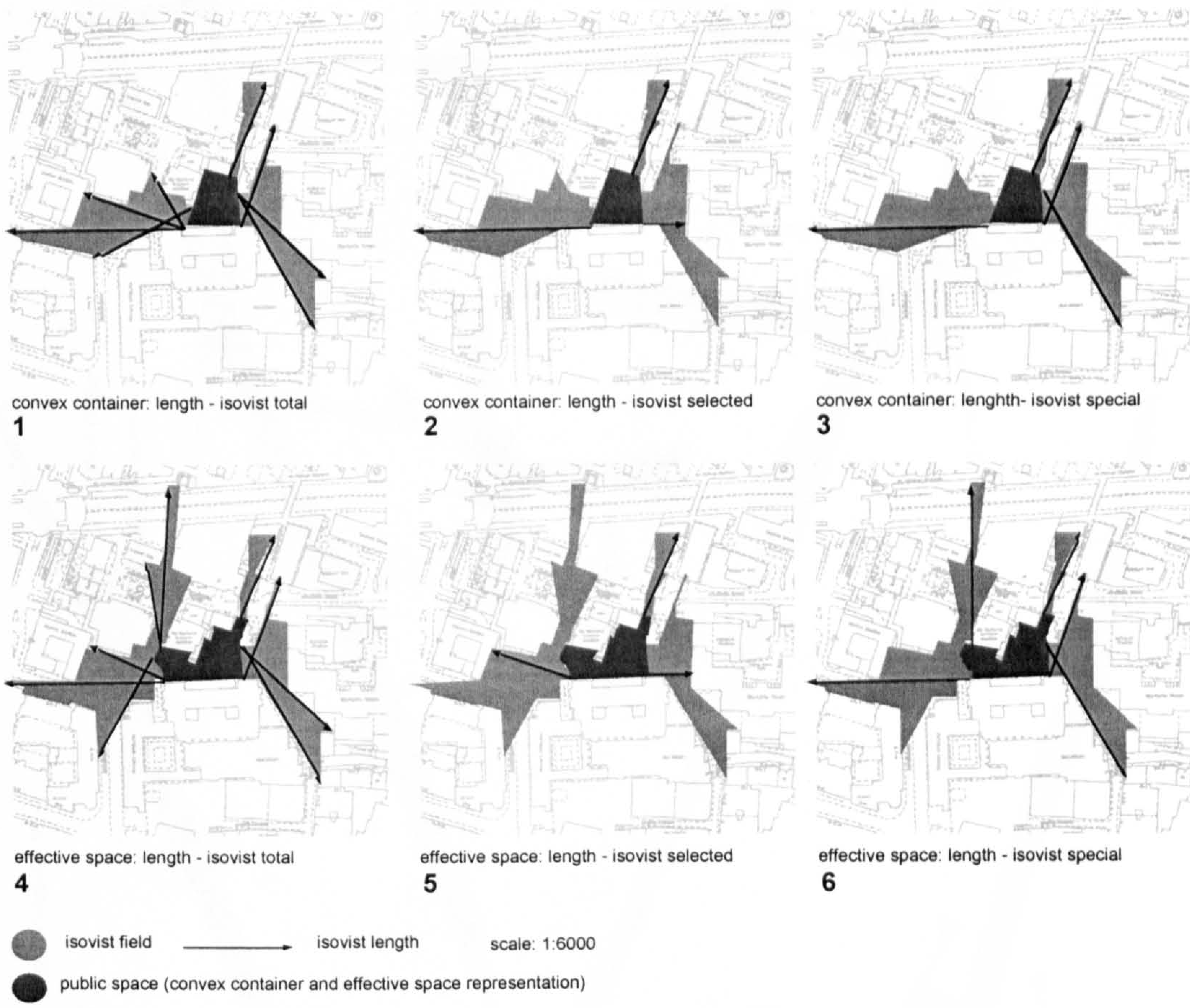

Figure 4.3. Different methods of measuring convex isovist length

[18] Note that isovist lengths were not measured when, due to particularities of the spatial element defining the public space, they were projected along car parks, recessed buildings entrances, etc.

Plate 4.15. Convex container isovists fields

scale: 1:6000

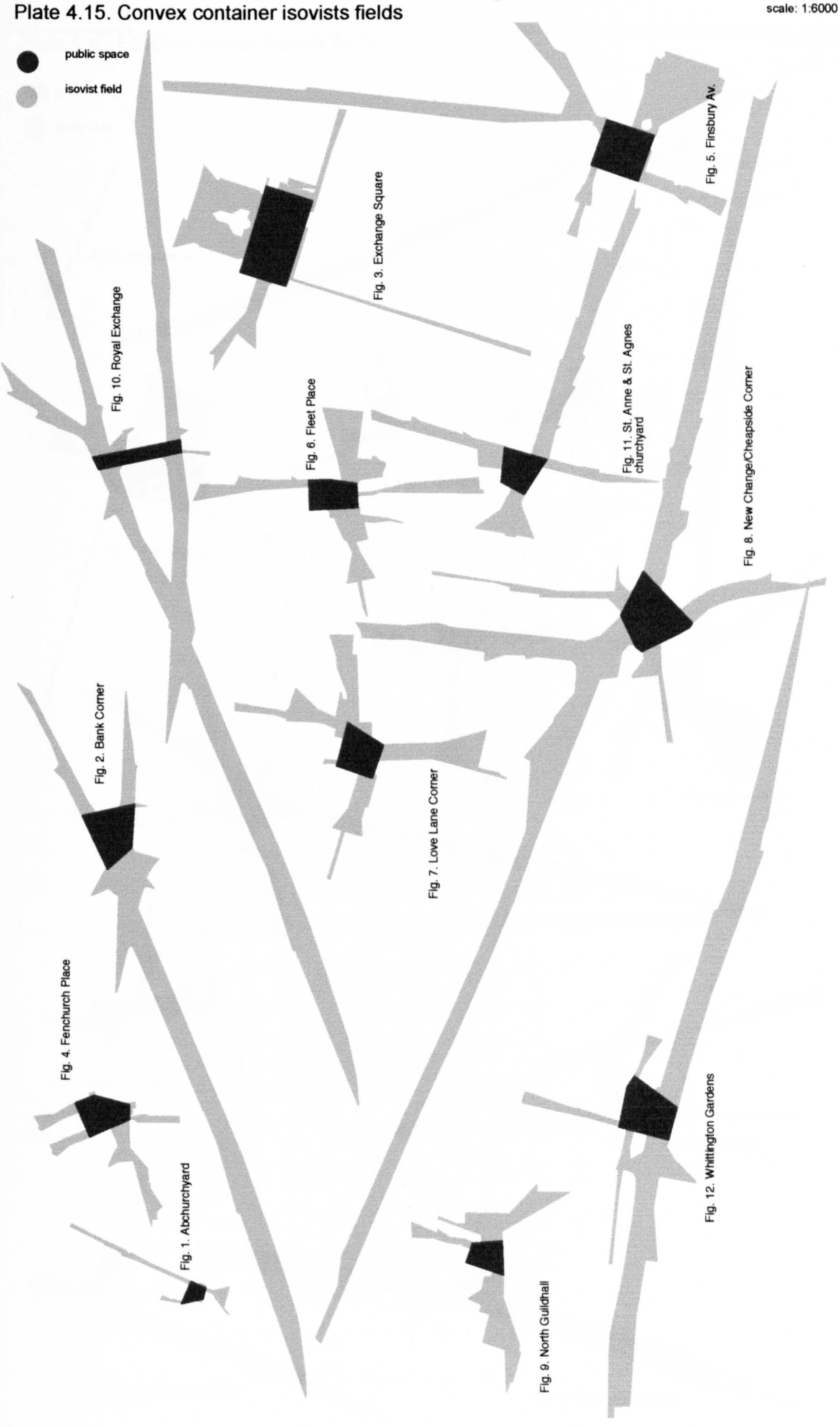

Plate 4.16. Effective spaces isovists fields

scale: 1:6000

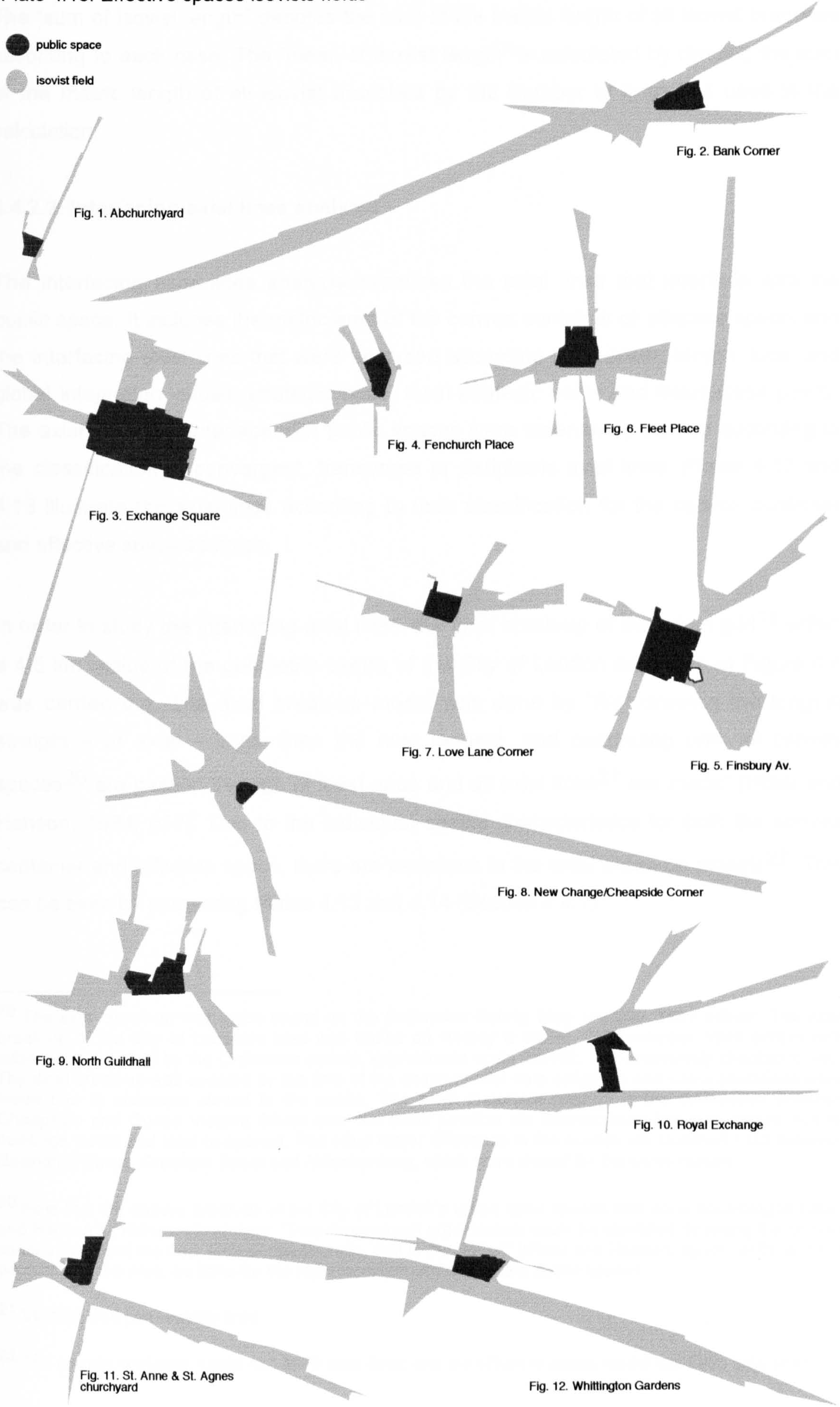

Fig. 1. Abchurchyard

Fig. 2. Bank Corner

Fig. 3. Exchange Square

Fig. 4. Fenchurch Place

Fig. 5. Finsbury Av.

Fig. 6. Fleet Place

Fig. 7. Love Lane Corner

Fig. 8. New Change/Cheapside Corner

Fig. 9. North Guildhall

Fig. 10. Royal Exchange

Fig. 11. St. Anne & St. Agnes churchyard

Fig. 12. Whittington Gardens

The "sum of isovist length" denotes the sum of the metric length of all isovist branches according to each case. The "mean of isovist length" is calculated by dividing the sum of the metric length of all isovist branches by the number of branches used in the calculation.

4.4.2.2. Interfacing axial lines analysis

The interfacing axial lines analysis examines the axial lines that interface with the public space. It includes the metric area of the convex container or effective space, and the interfacing axial lines that were analysed according to: number, length, local and global integration values, strategic value, local strategic value and intersection points. The axial lines that interface with public spaces were extensively studied according to the classification in convergent, transverse or peripheric axial lines. Plates 4.17 and 4.18 illustrate the axial lines according to their classification for the convex container and effective space samples.

In order to study the interfacing axial lines, the axial break-up of the urban grid[19] within a 4.5 km radius of the geometric centre of the City of London as shown in Figure 4.4 was carried out. The axial break-up model was done by "first drawing the longest straight – or axial – lines, then the next longest, and continuing until all convex spaces[20] are passed through at least once and all axial links[21] are made" (Hillier and Hanson, 1984, p17). Due to the individual spatial characteristics for both the convex container and effective space, there are variations in the axial break-up models[22]. This can be seen by comparing Plates 4.13 and 4.14 (Section 4.4.1).

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[19] The axial break-up was made based on the Ordinance Survey Map 1:10000, 1991 edition. The axial break-up of the City of London's area was based on Healey & Baker, 14 November 1994 edition with information supplied by the Ordinance survey, approximate scale 1:3448, and extensively checked in situ. The axial break-up was updated by the time of the observational data collection and some alterations were made due to accesses closed to the public. The most important change is the connection between Cheapside and Queen Victoria Street near the Bank junction via Bucklersbury that was closed due to buildings works and later re-opened. The other major difference is the access via Guildhall Yard between Basinghall Street, Gresham Street and Aldermanbury, which were closed for the same reason.

[20] Note that the convex break-up of the City of London's urban open spaces was done according to Hillier and Hanson's (1984) methodology: "Two-dimensional organisation could be identified by taking the convex spaces that have the best area-perimeter ratio, that is the fattest" (Hillier and Hanson, op.cit., p16), and not according to the area, as done for the representation of the selected public spaces.

[21] Visibility and permeability links.

[22] The convex container model has 5679 axial lines, and the effective space model has 5685 axial lines.

Plate 4.17. Convex container representation showing types of axial lines and intersection points
scale: 1:3500

convex container
intersection points
remaining axial lines
convergent axial lines
transverse axial lines
peripheric axial lines

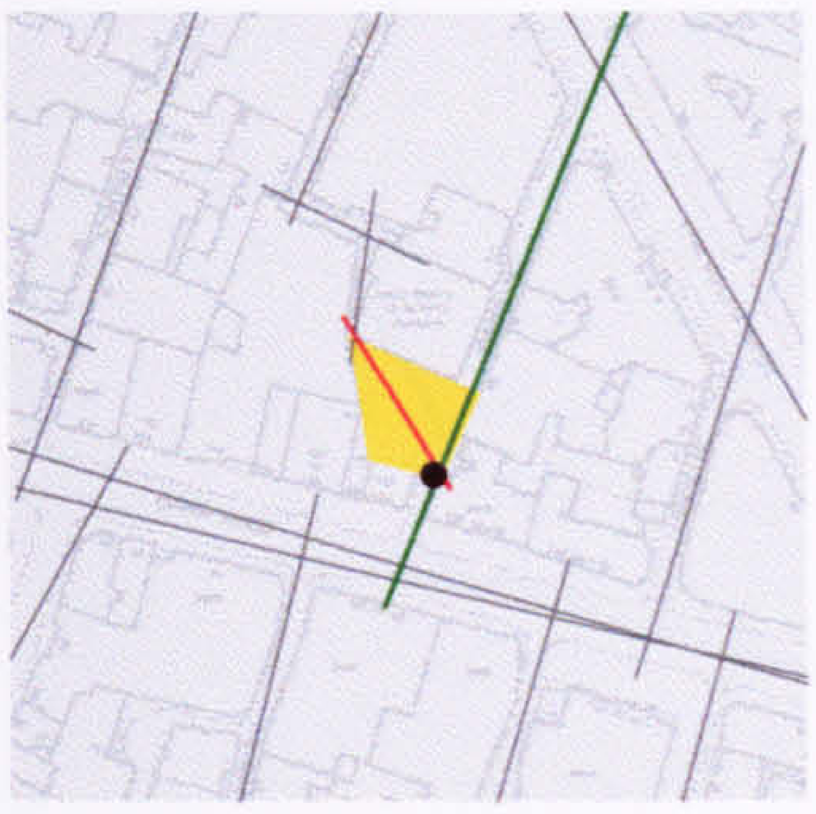
Fig. 1. Abchurchyard


Fig. 2. Bank Corner

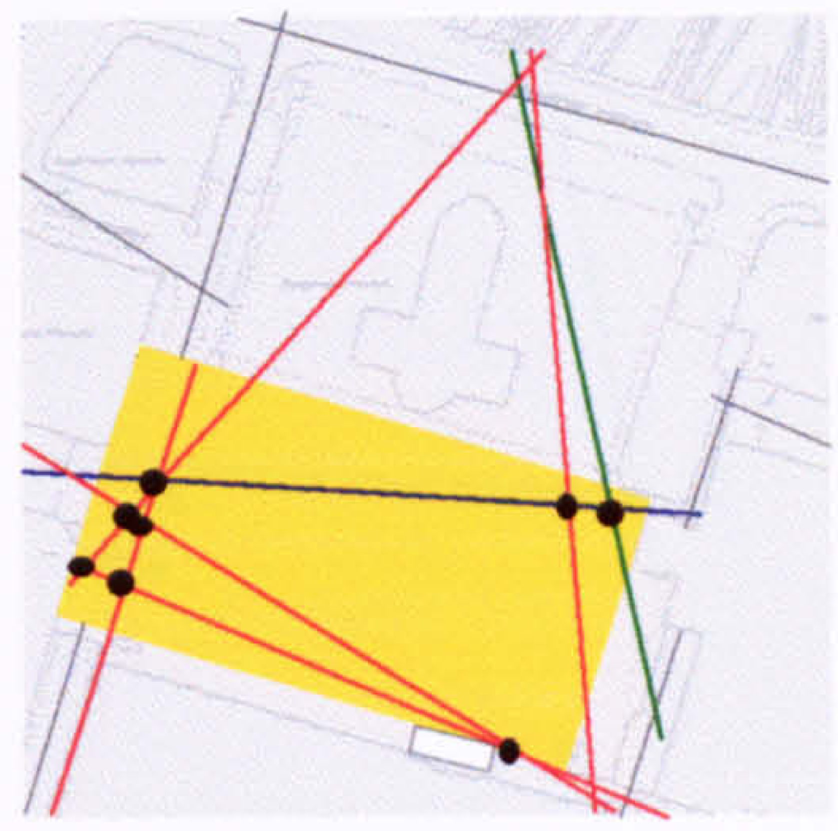
Fig. 3. Exchange Square


Fig. 4. Fenchurch Place


Fig. 5. Finsbury Av.

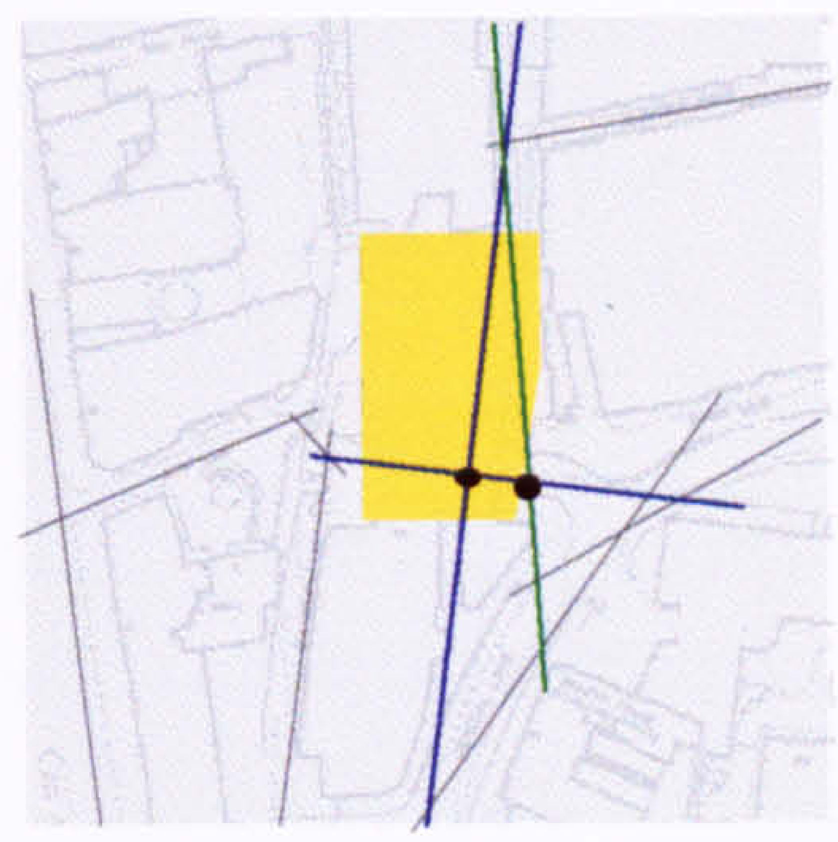
Fig. 6. Fleet Place

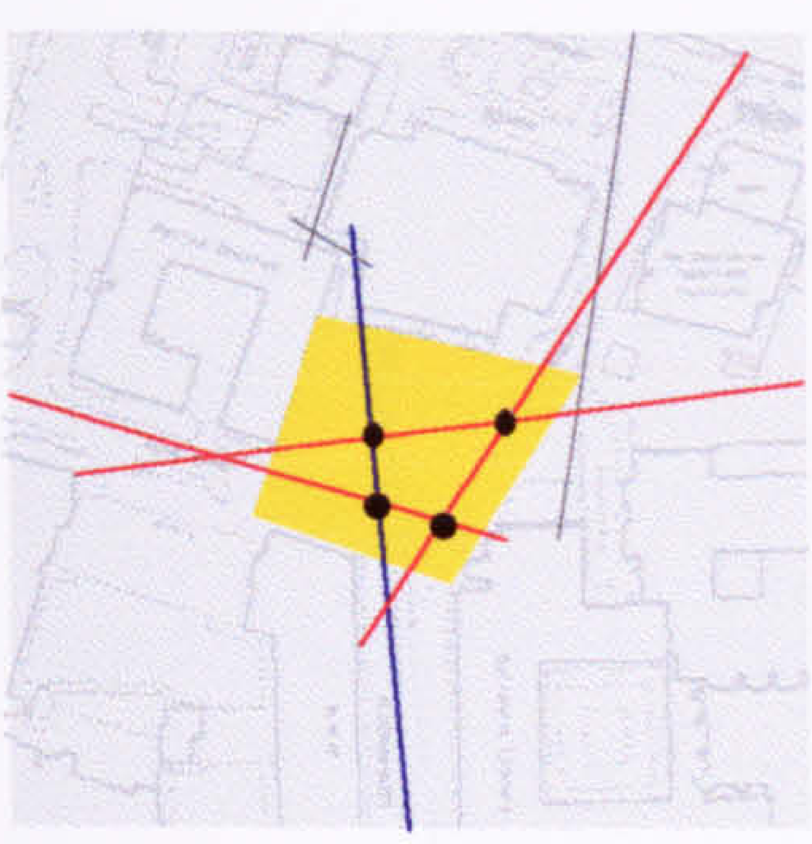
Fig. 7. Love Lane Corner


Fig. 8. New Change/Cheapside Corner


Fig. 9. North Guildhall


Fig. 10. Royal Exchange


Fig. 11. St. Anne & St. Agnes churchyard

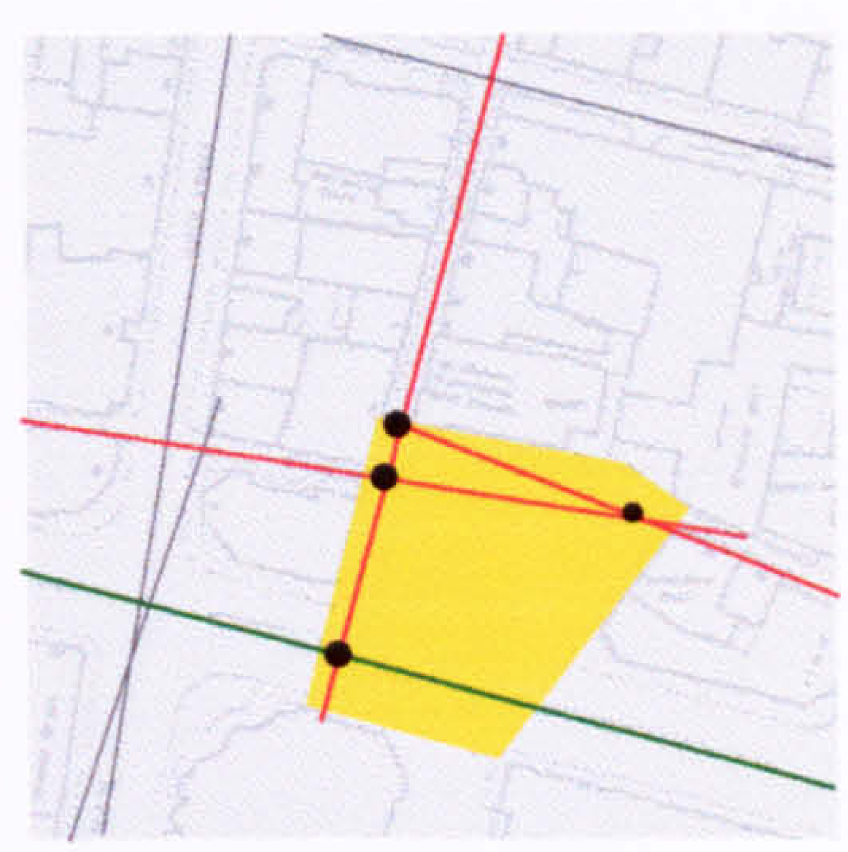
Fig. 12. Whittington Gardens

Plate 4.18. Effective space representation showing types of axial lines and intersection points
scale: 1:3500

effective space
intersection points
remaining axial lines
convergent axial lines
transverse axial lines
peripheric axial lines

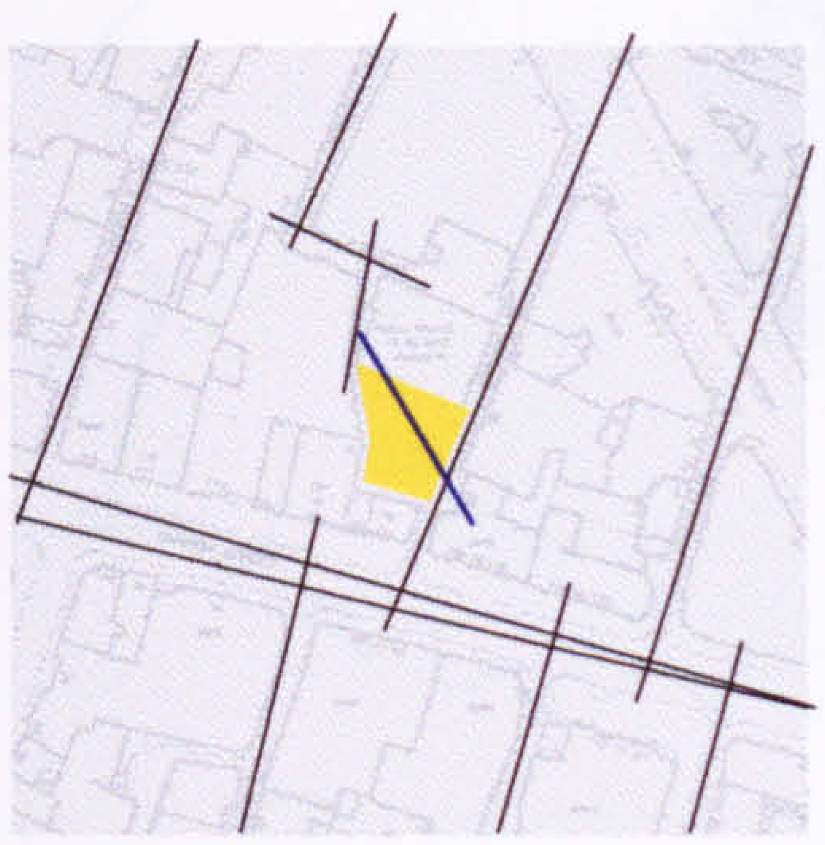
Fig. 1. Abchurchyard

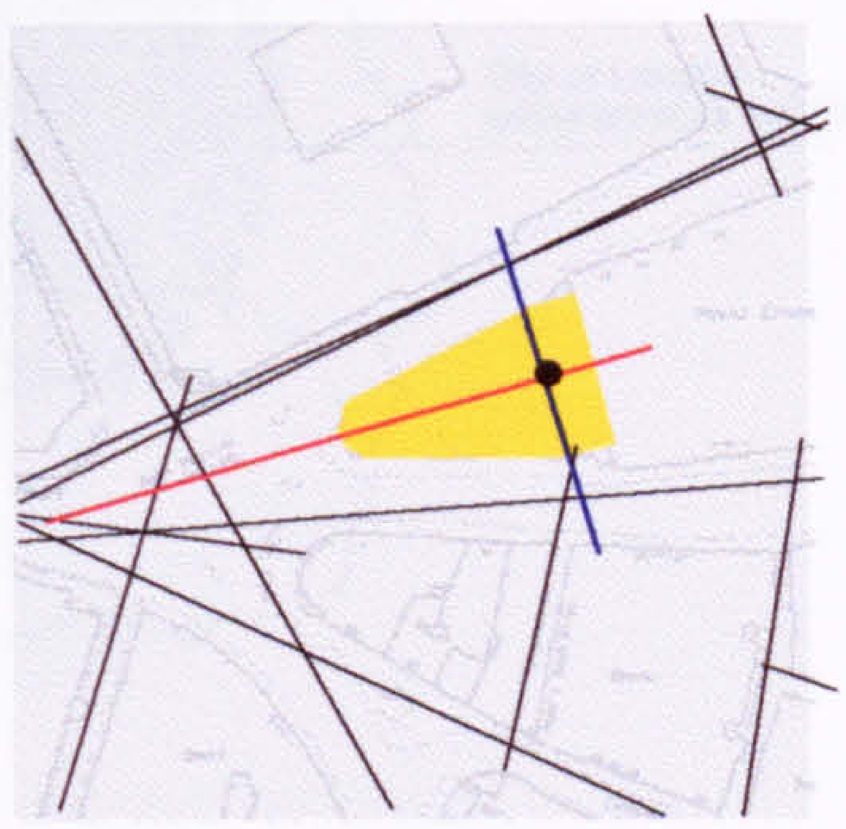
Fig. 2. Bank Corner

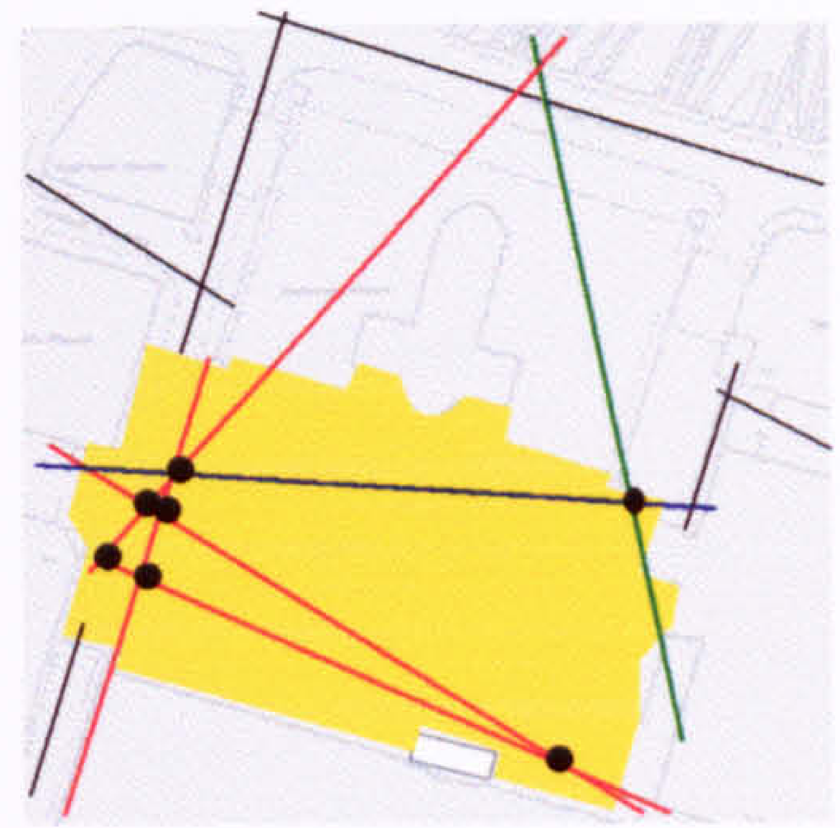
Fig. 3. Exchange Square

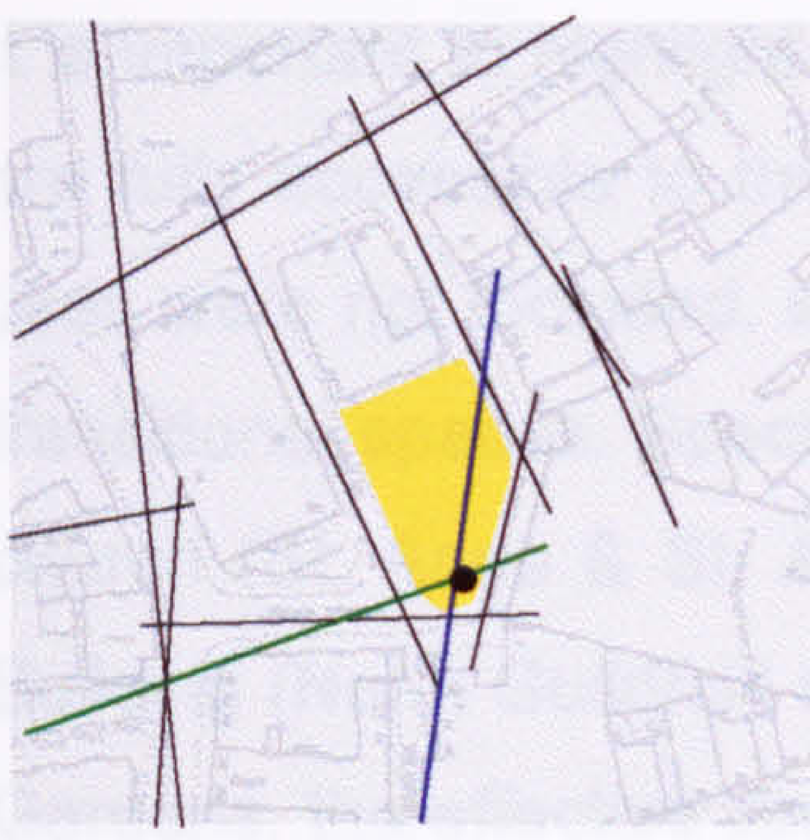
Fig. 4. Fenchurch Place


Fig. 5. Finsbury Av.


Fig. 6. Fleet Place

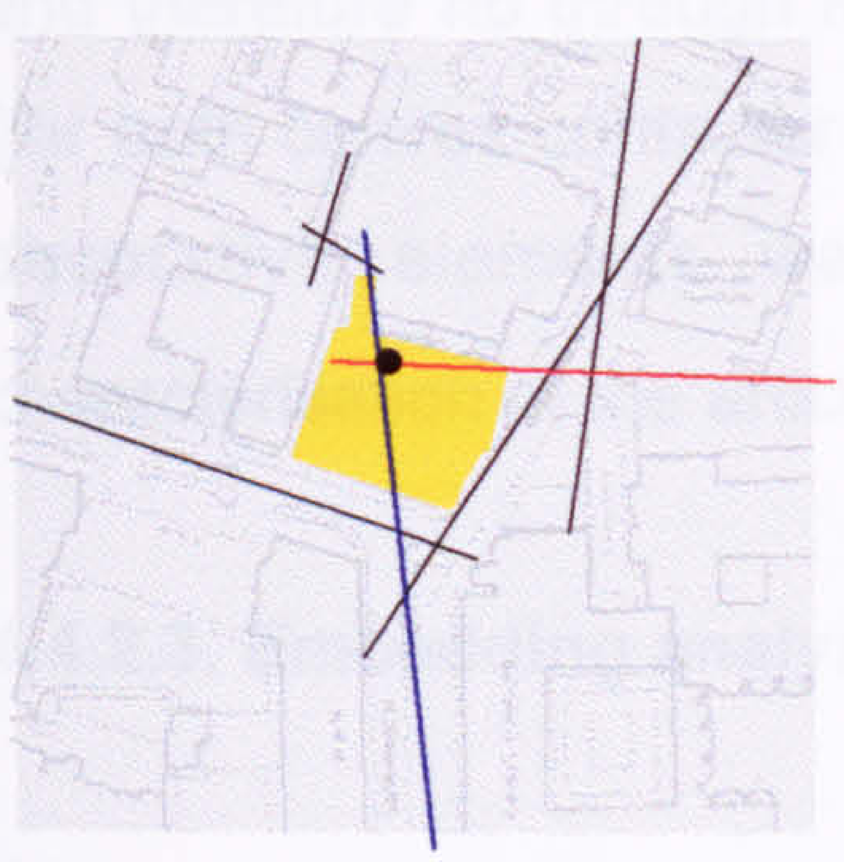
Fig. 7. Love Lane Corner

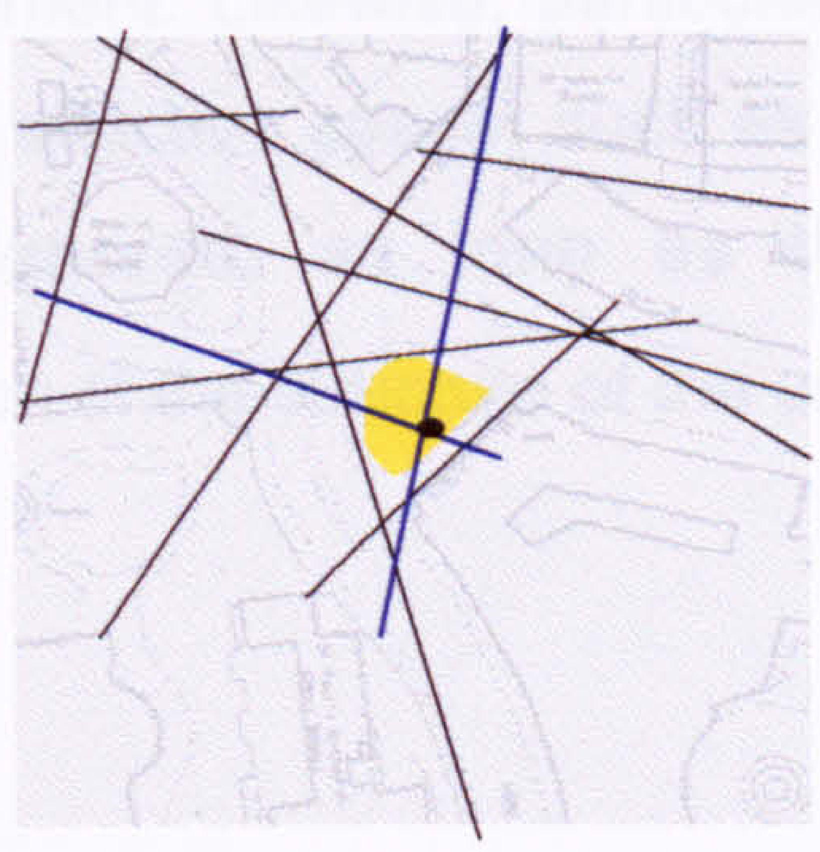
Fig. 8. New Change/Cheapside Corner

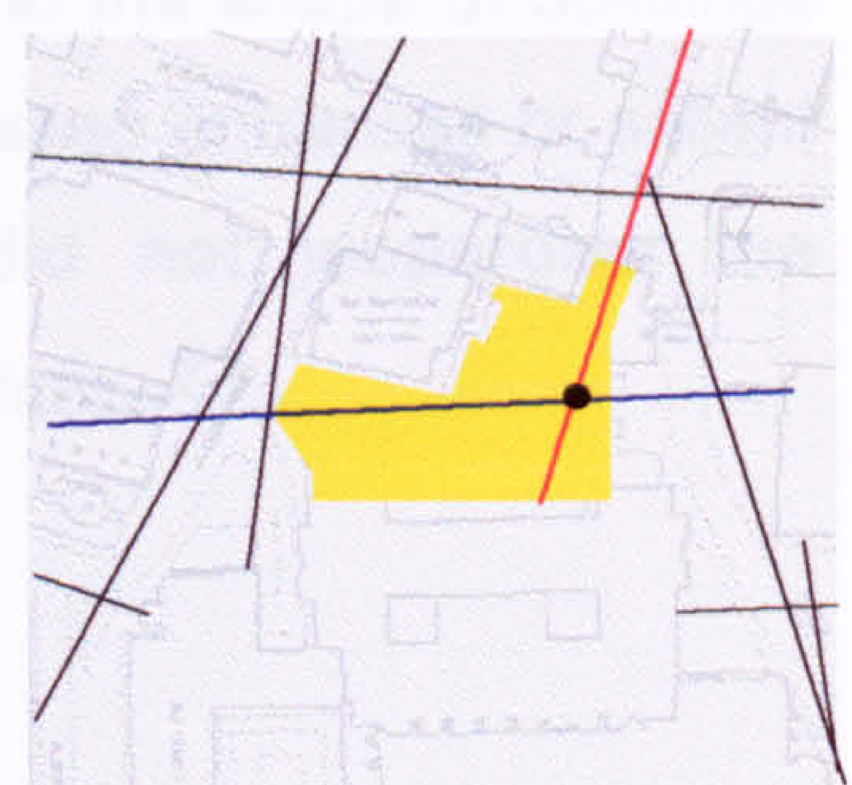
Fig. 9. North Guildhall

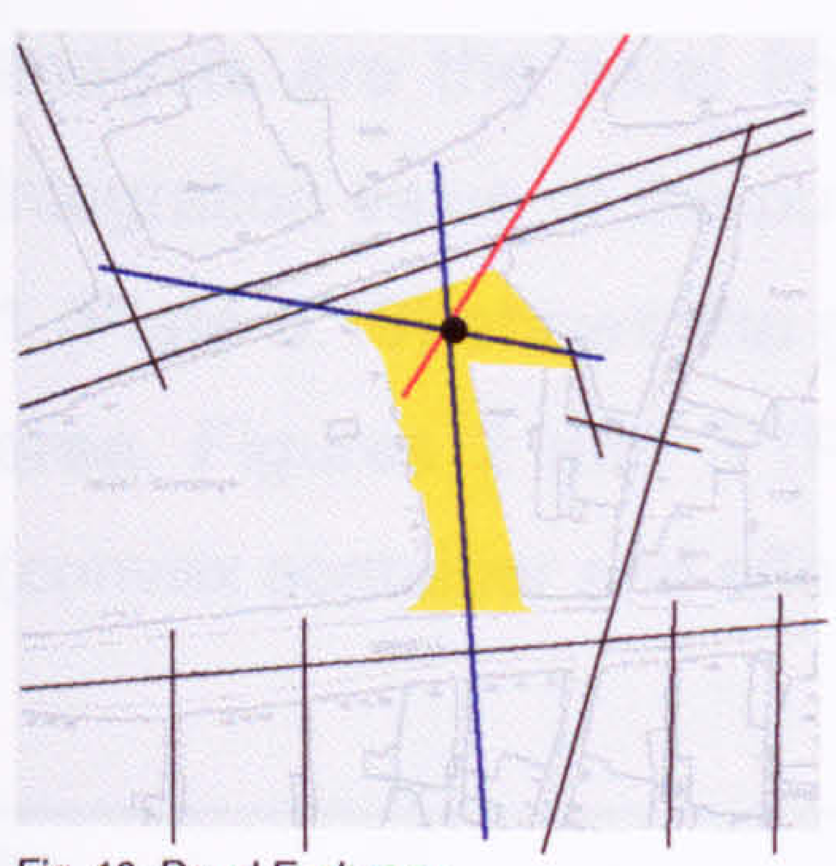
Fig. 10. Royal Exchange


Fig. 11. St. Anne & St. Agnes churchyard


Fig. 12. Whittington Gardens

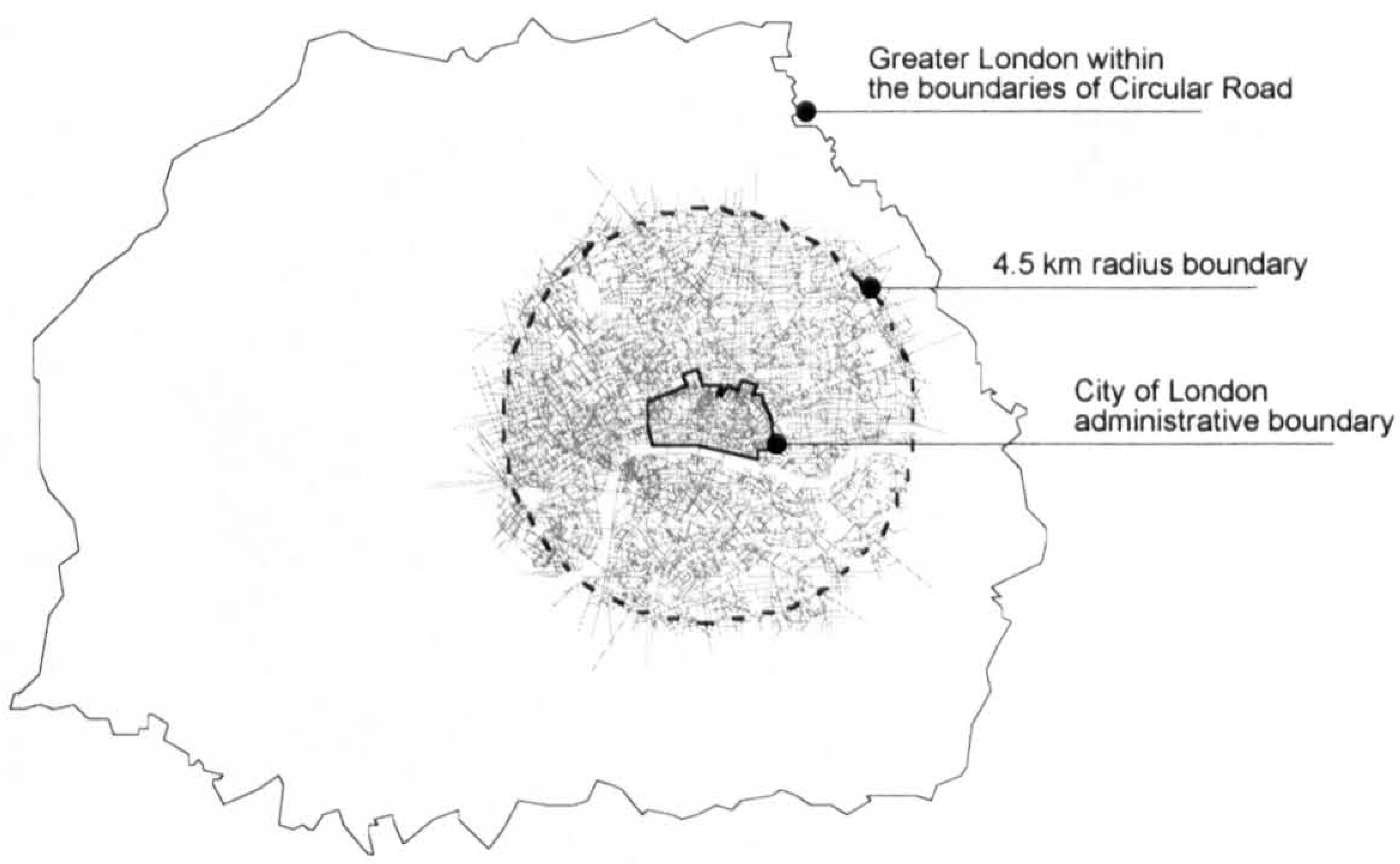

Figure 4.4. Axial break-up area in the context of Greater London

It is important to highlight that for the convex and axial break-ups, only the spaces that are fully accessible to the public were modelled. Hence, spaces restricted to specific uses were not included, such as car parks, even if theoretically they could be used as transitional spaces. Specific to this research, the back access to St. Anne & St. Agnes church (St. Anne & St. Agnes churchyard effective space) and Chartered Insurance Building (North Guildhall effective space) were not modelled. In the case of Whittington Gardens, the effective space was not linked to the pedestrian street (refer to paragraph 4.1.3.12) since there is not a continuous permeability and visual link between the two and therefore no through movement. Likewise, particularities in the shape of buildings (for both convex container and effective space) such as recessed entrances or salient decorative elements were ignored, as long as this did not jeopardise the characterisation of the articulation of the structure of the urban fabric[23].

4.4.2.3. Embedding analysis

The embedding analysis focuses on the analysis of public spaces in relation to the large scale structure of the urban fabric. The measures used for the embedding analysis are the axial lines' local (R3) and global (Rn) integration values and the integration value of the public space as defined in Section 3.3.3.3. of Chapter 3. Figure 1 (Plate 4.19) shows the global integration map (convex container model) of the study area. Figures 2 and 3 (Plate 4.19) illustrate sections of the global integration map (convex container and effective space) highlighting the location of public spaces.

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[23] Refer to Hillier and Hanson, 1984, p98; and Major, 1998, p10.

Plate 4.19. Convex container and effective space representations global integration axial maps

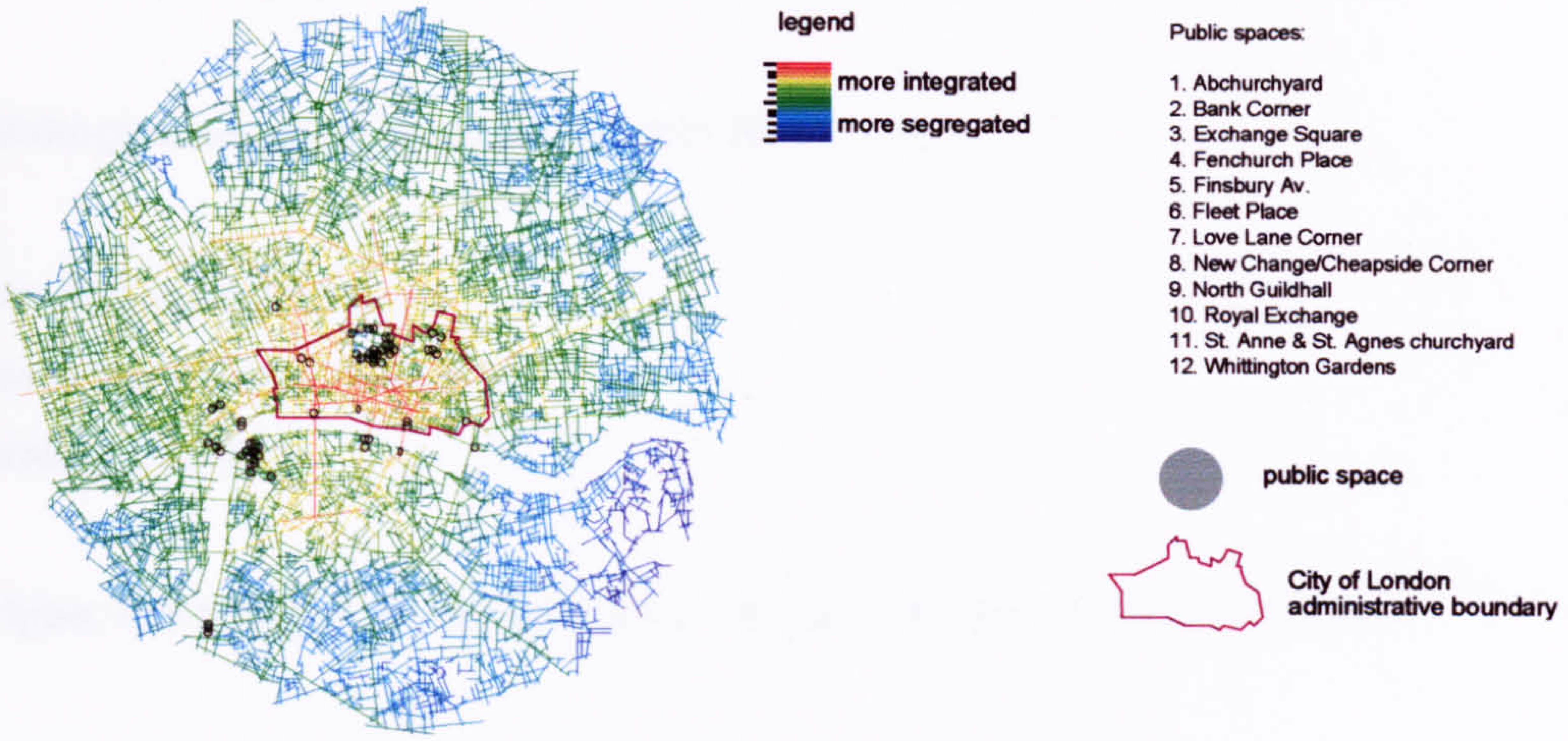

Fig. 1. Study area global integration map (convex container model)

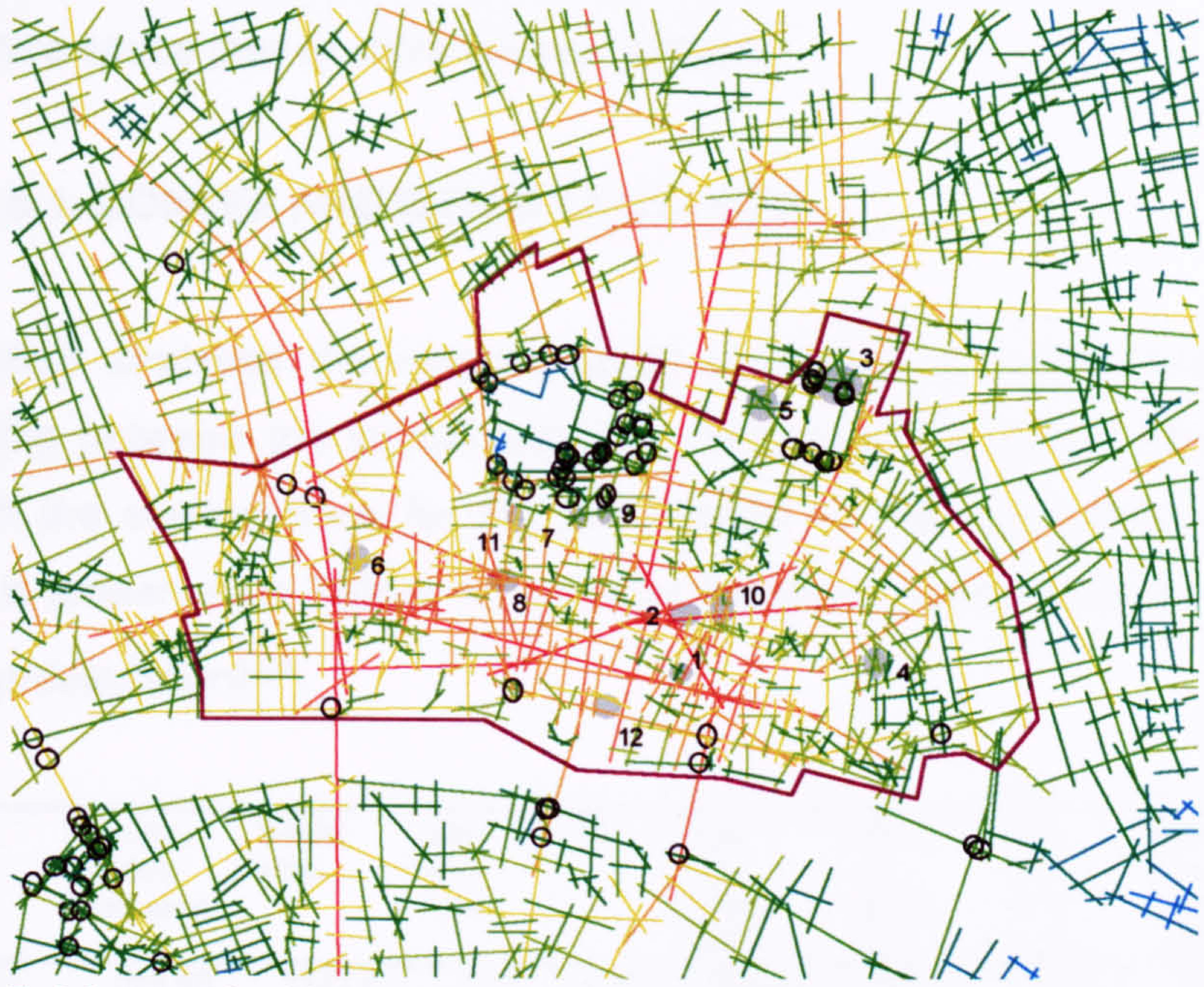

Fig. 2. Convex container global integration map

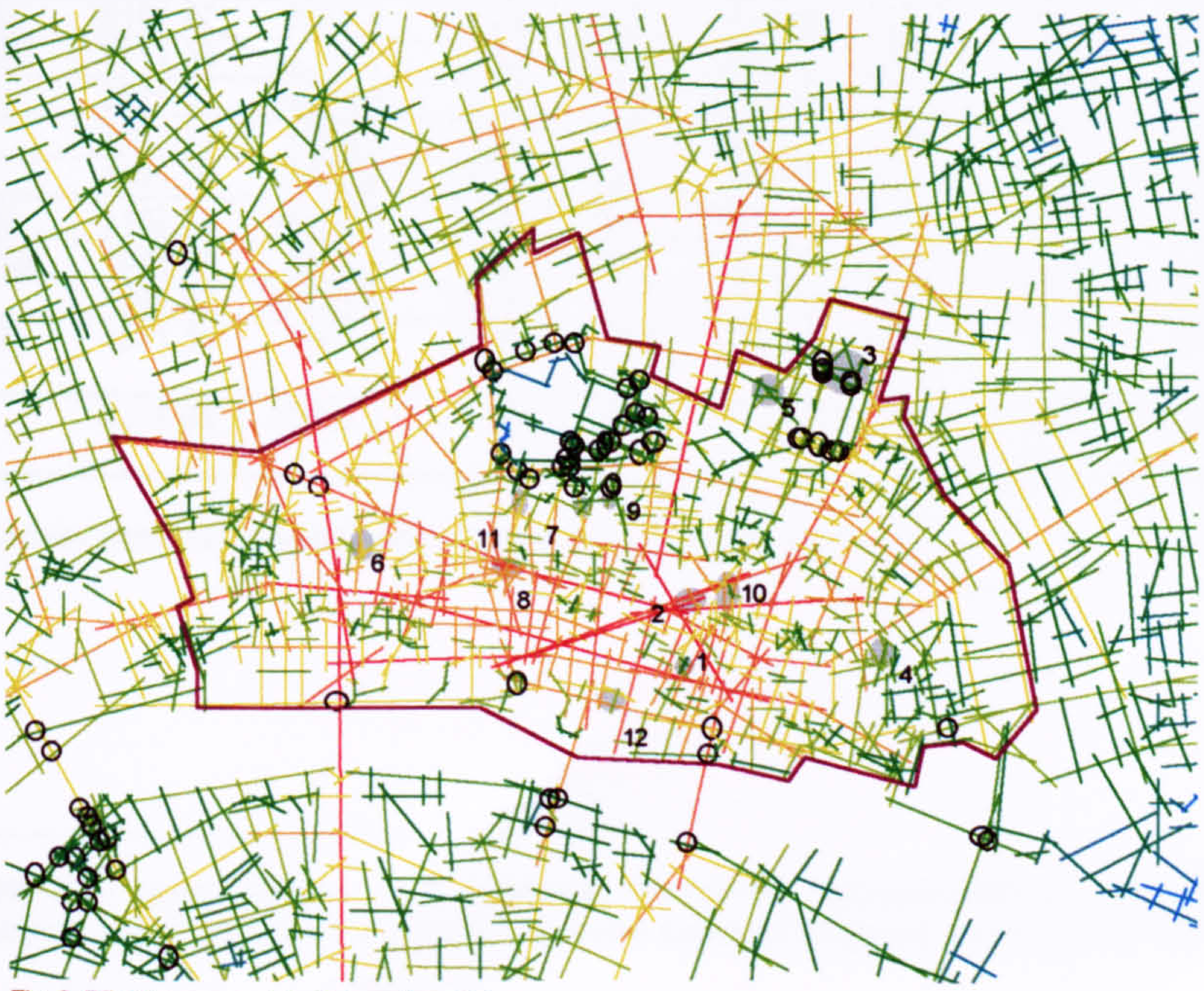

Fig. 3. Effective space global integration map

4.5. THE MORPHOLOGICAL ANALYSIS

The morphological analysis is separated into three types:

1. Convex and isovist analysis
2. Interfacing axial lines analysis
3. Embedding analysis

For each type, the analysis is carried out for the two models of representation:

A. Convex container (only one convex space)
B. Effective space (two or more convex spaces)

4.5.1. CONVEX AND ISOVIST ANALYSIS

This section analyses the morphological properties of public spaces through the relationship between the spatial element comprising the public space and its visual links with the surroundings for the two models of representation. Data used in the analysis is presented in Tables 4.7 (convex container representation) and 4.8 (effective space representation)[24].

	Convex container area	Isovist area	Visi-bility ratio	ER	Sum isov. length total	Mean isov. length total	Sum isov. length select.	Mean isov. length select.	Sum isov. length special	Mean isov. length special
Abchuchyard	383.60	1137.5	2.97	6.76	236.60	59.15	196.9	65.65	208.6	69.53
Bank Corner	2453.16	39742.5	16.20	1.89	3338.40	256.80	1593.3	398.31	2629.4	438.24
Exchange Sq.	5161.47	9067.4	1.76	0.41	915.46	101.72	810.9	101.36	732.8	104.69
Fenchurch Pl.	1711.09	2753.7	1.61	2.83	315.18	63.04	260.2	65.06	260.2	65.06
Finsbury Av.	2825.51	14403.0	5.10	2.62	1385.10	173.14	1052.9	175.48	1052.9	175.48
Fleet Place	1613.14	7324.5	4.54	1.63	568.42	94.74	547.1	109.41	547.1	109.41
Love Lane	1865.76	7419.8	3.98	0.95	763.47	95.43	452.2	90.43	502.1	100.43
New Change	3462.63	38453.9	11.10	0.62	2992.10	249.34	2246.6	320.94	2191.0	365.17
North Guildhall	1079.74	5473.7	5.07	2.49	672.70	84.09	198.4	99.21	381.0	95.24
Royal Exch.	1394.22	28201.8	20.20	1.12	2191.70	219.12	2033.9	254.24	1973.2	281.89
St Anne & St Agnes	1571.36	9047.3	5.76	1.35	1226.30	136.25	653.4	163.36	653.4	163.36
Whittington Gardens	2735.06	19950.1	7.29	1.97	1744.30	193.81	1203.7	240.74	1203.7	240.74

Table 4.7. Convex container representation convex and isovist analysis data

[24] The general data Tables 4.3 (convex container representation) and 4.4 (effective space representation), which compile the data for all three types of analysis, are found in Appendix 2.

Names	Effective space area	Isovist area	Visibi-lity ratio	ER	Sum isov. length total	Mean isov. length total	Sum isov. length select.	Mean isov. length select.	Sum isov. length special	Mean isov. length spec.
Abchuchyard	322.99	1024.7	3.17	2.82	197.63	65.88	197.63	65.88	197.63	65.9
Bank Corner	1019.85	17951.1	17.60	0.59	1378.70	137.87	978.49	244.62	916.11	305.4
Exchange Sq.	6371.41	8114.9	1.27	3.37	867.95	96.44	770.59	96.32	697.99	99.7
Fenchurch Pl.	830.98	3595.4	4.33	0.22	331.59	66.32	280.01	70.00	280.01	70.0
Finsbury Av.	2957.79	14331.9	4.85	3.34	1383.8	172.97	1051.6	175.26	1051.60	175.3
Fleet Place	1493.24	7459.6	5.00	2.82	562.94	93.82	541.73	108.35	541.73	108.4
Love Lane	918.74	7419.7	8.08	1.16	546.66	91.11	480.01	96.00	480.01	96.00
New Change	288.61	22541.5	78.10	0	2012.20	201.22	1609.4	229.91	1528.90	254.8
North Guildhall	1666.82	7144.6	4.29	3.18	749.98	83.33	120.77	60.39	463.67	92.73
Royal Exch.	1170.33	12157.9	10.39	2.56	1419.40	141.94	1314.9	164.35	1262.70	180.4
St Anne & St Agnes	1095.90	9213.5	8.41	0.61	1258.10	139.79	646.55	161.64	646.55	161.6
Whittington Gardens	984.30	19263.0	19.57	0.13	1640.30	182.26	1086.5	217.31	1086.50	217.3

Table 4.8. Effective space representation convex and isovist analysis data

4.5.1.1. Convex container representation

The mean area for the convex container sample is 2188.06 m^2, with a large variation amongst the cases, ranging from 383.60 (Abchurchyard) to 3462.63 m^2 (New Change/Cheapside Corner). The mean area for the convex isovist is 15247.92 m^2. Although the sum of isovist length varies for the three methods (isovist total: 1362.43 metres (m), isovist selected: 937.46 m, and isovist special: 1027.96 m), the mean of isovist length showed to be very similar (isovist total: 143.88 m, isovist selected: 173.68 m, and isovist special: 184.10) with a mean visibility ratio of 7.13. The enclosure ratio is 2.05 but also varies considerably amongst the cases of the sample, ranging from 0.41 (Exchange Square) to 6.76 (Abchurchyard). There are three cases in the sample (Exchange Square, Love Lane Corner and New Change/Cheapside Corner) where the amount of unbuilt perimeter prevailed against the built perimeter. Those three cases correspond to 25% of the sample, which is more than twice the occurrence compared to the European squares' data (see Table 4.3, Appendix 2).

Following the same analytical procedure for traditional European squares, the convex container sample was tested for the relationship between public space area and its visibility connections (Fig. 4.5). In addition the analysis included the sum and mean of isovist length according to the three methods (Section 4.4.2.1), in Figures 4.6 to 4.8, next.

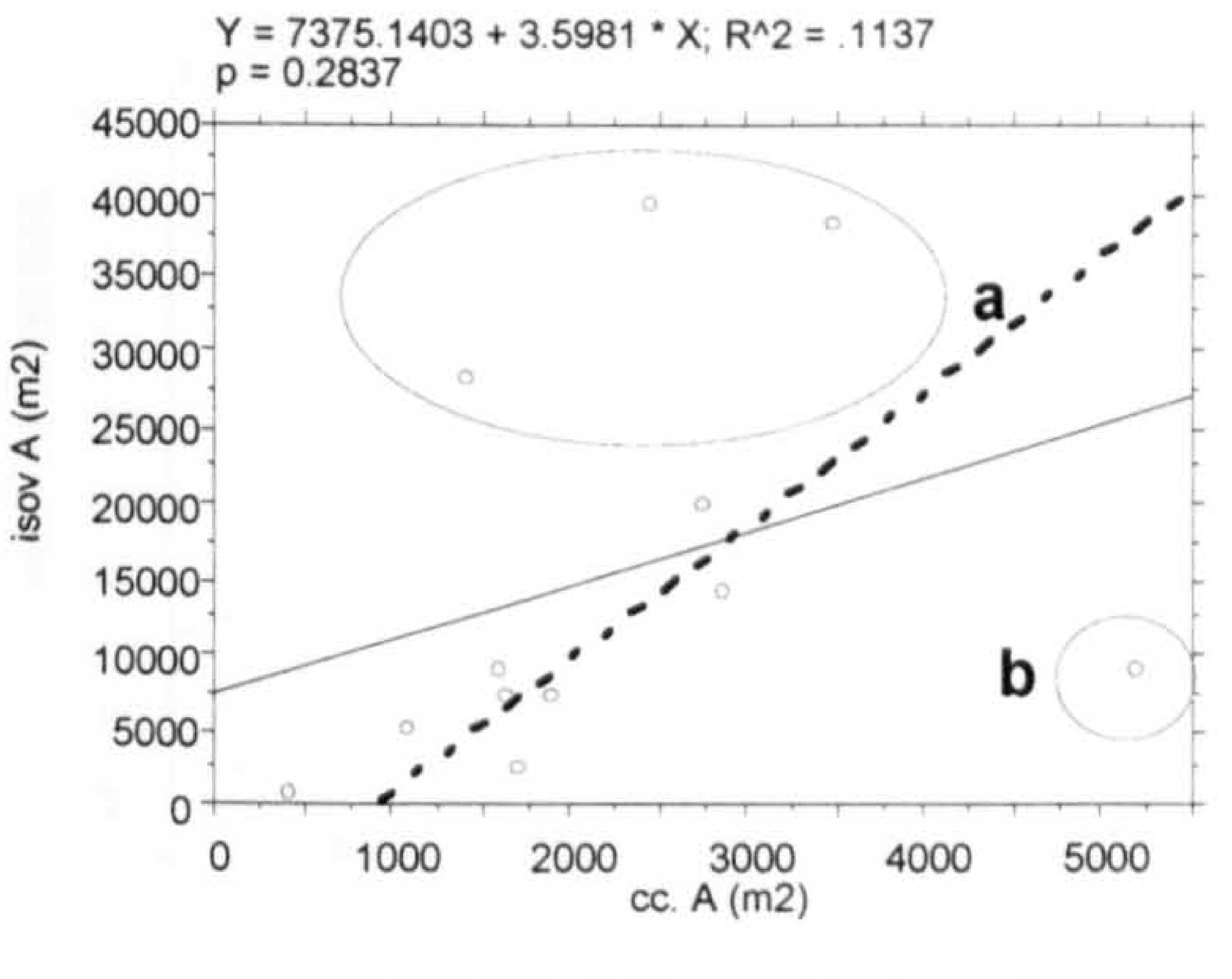

Figure 4.5. Scattergram convex container area and convex isovist area

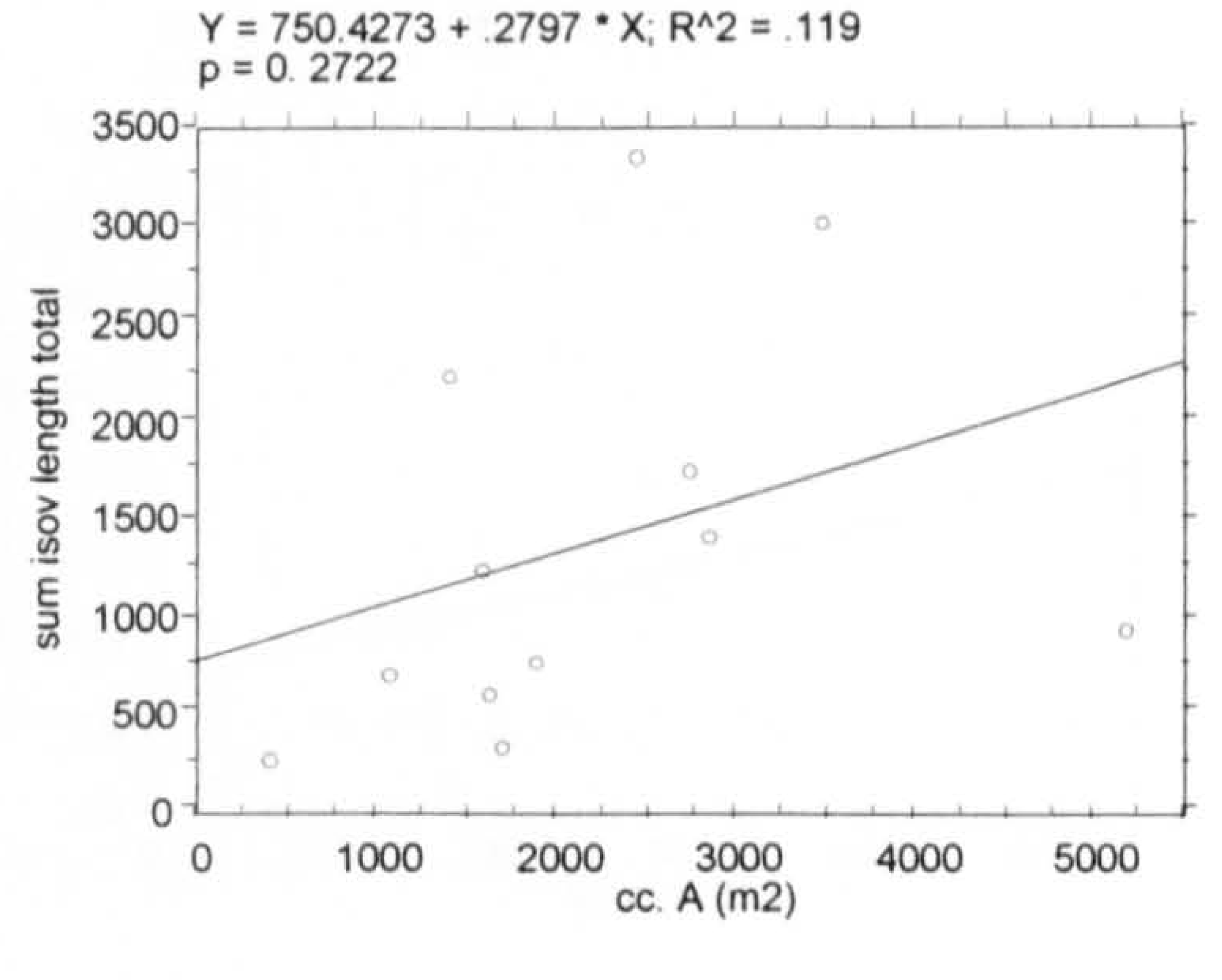

Figure 4.6. Scattergram convex container area and sum of isovist length (total)

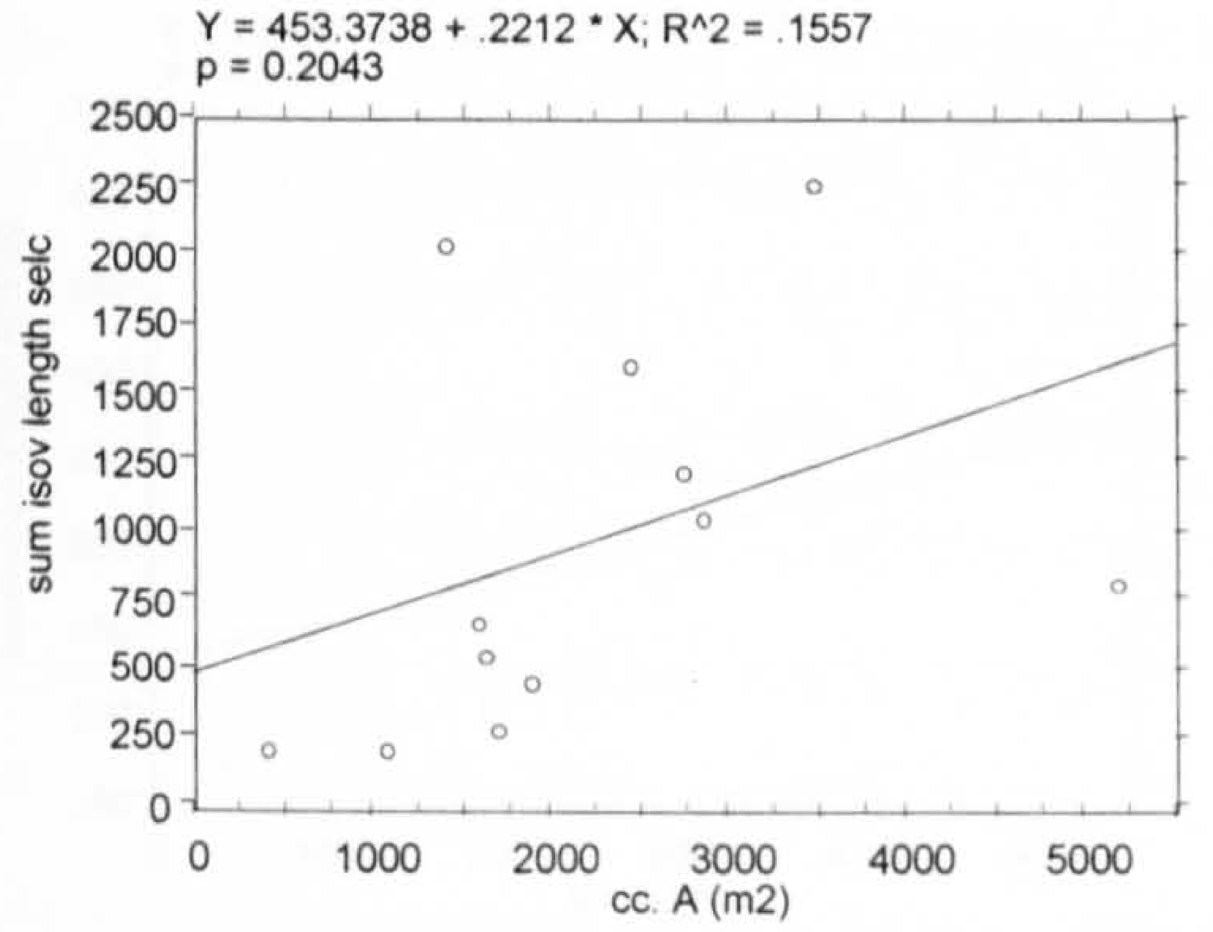

Figure 4.7. Scattergram convex container area and sum of isovist length (selected)

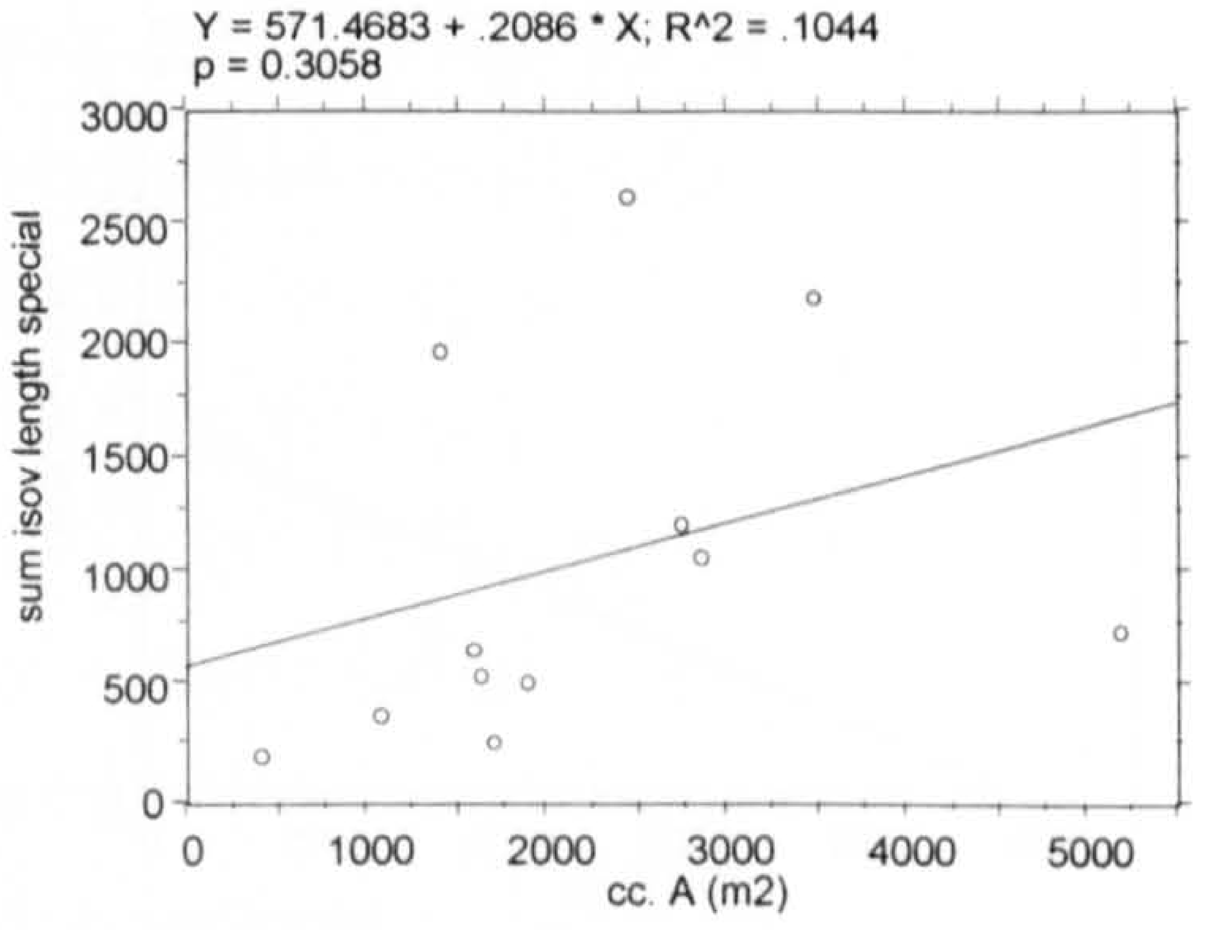

Figure 4.8. Scattergram convex container and sum of isovist length (special)

N = 12 for all cases

The analysis showed a weak correlation between convex container areas and isovist areas, as well as for the sum of isovist lengths including all three methods. The weak correlations (as exemplified in Fig. 4.5) are explained by the extremely long isovists for Bank, New Change and Royal Exchange (top three points, area "a") along the exceptional junction composed of Cheapside, Queen Victoria, King William, Cornhill and Threadneedle Streets. Exchange Square (bottom right point, area "b" in Figure 4.4) is in fact the only case that is over enclosed for its size in comparison to the other cases of the sample. For the remaining eight cases, however, the data suggests that the larger the convex container, the larger its visual connection to the surroundings. This is illustrated by the "dotted" regression line which was re-calculated based on these eight points overlaid in Figure 4.5. Also, only a weak correlation was found (using any of the three methods) when assessing the relationship between the convex container areas and the mean of isovist lengths (Figs. 4.9 to 4.11).

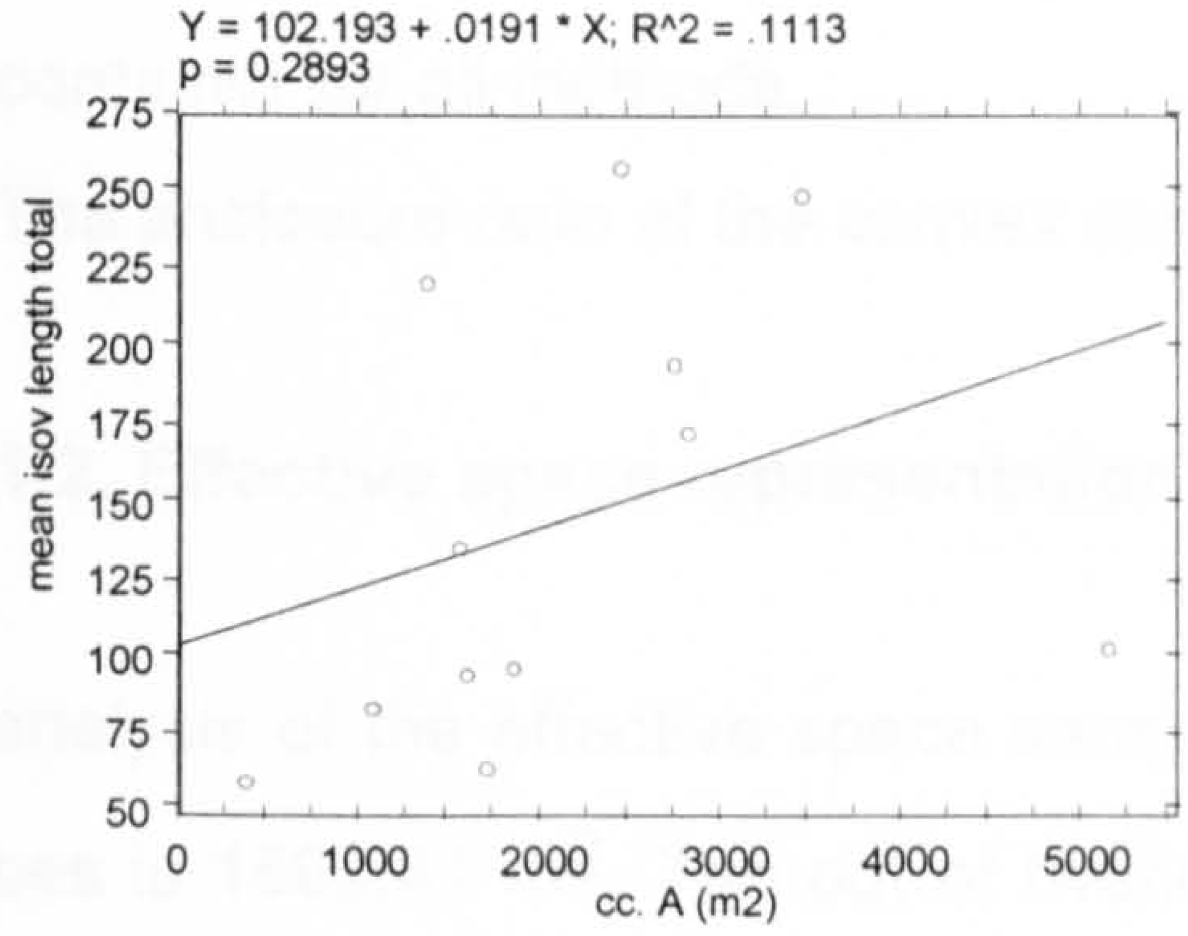

Figure 4.9. Scattergram convex container area and mean of sum of isovist length (total)

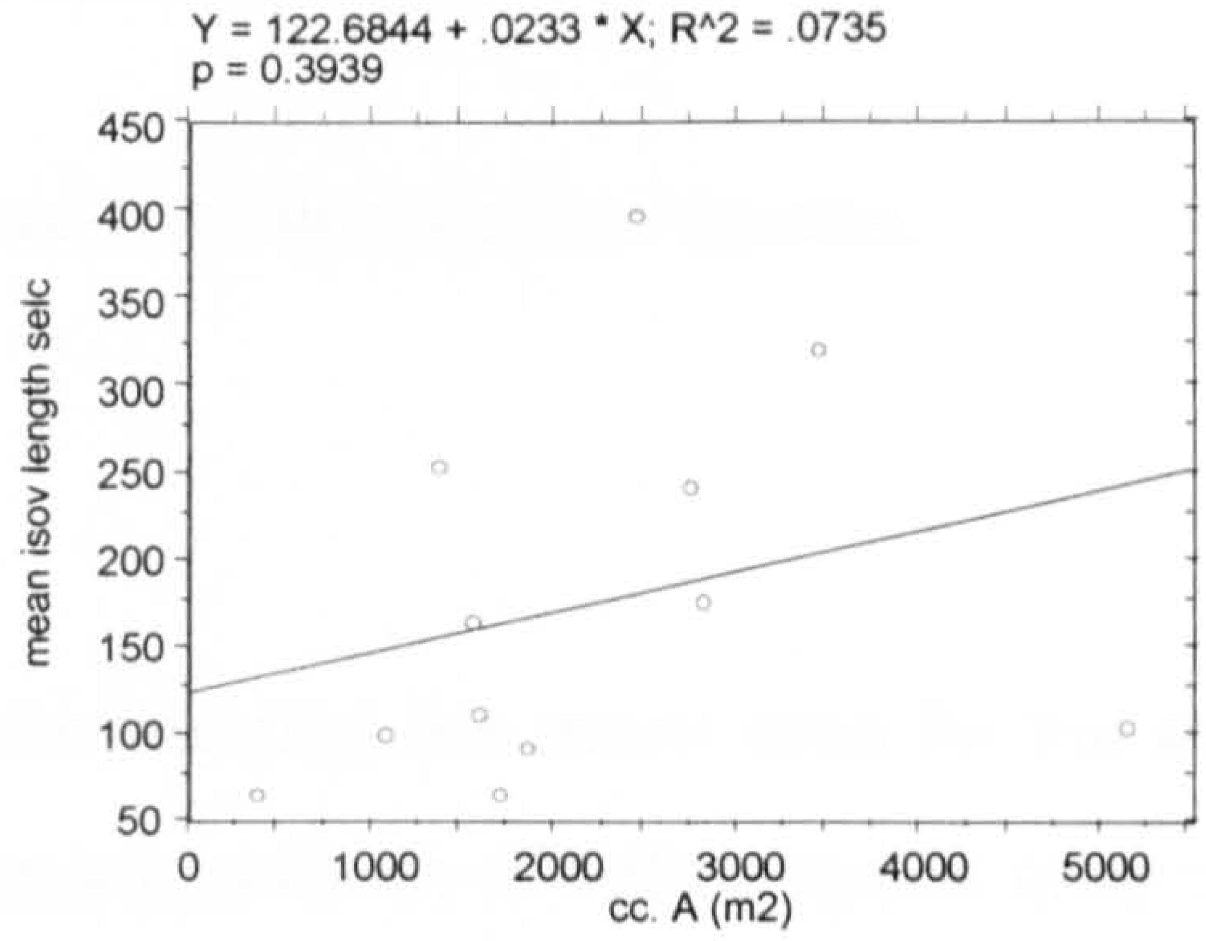

Figure 4.10. Scattergram convex container and mean of sum of isovist length (selected)

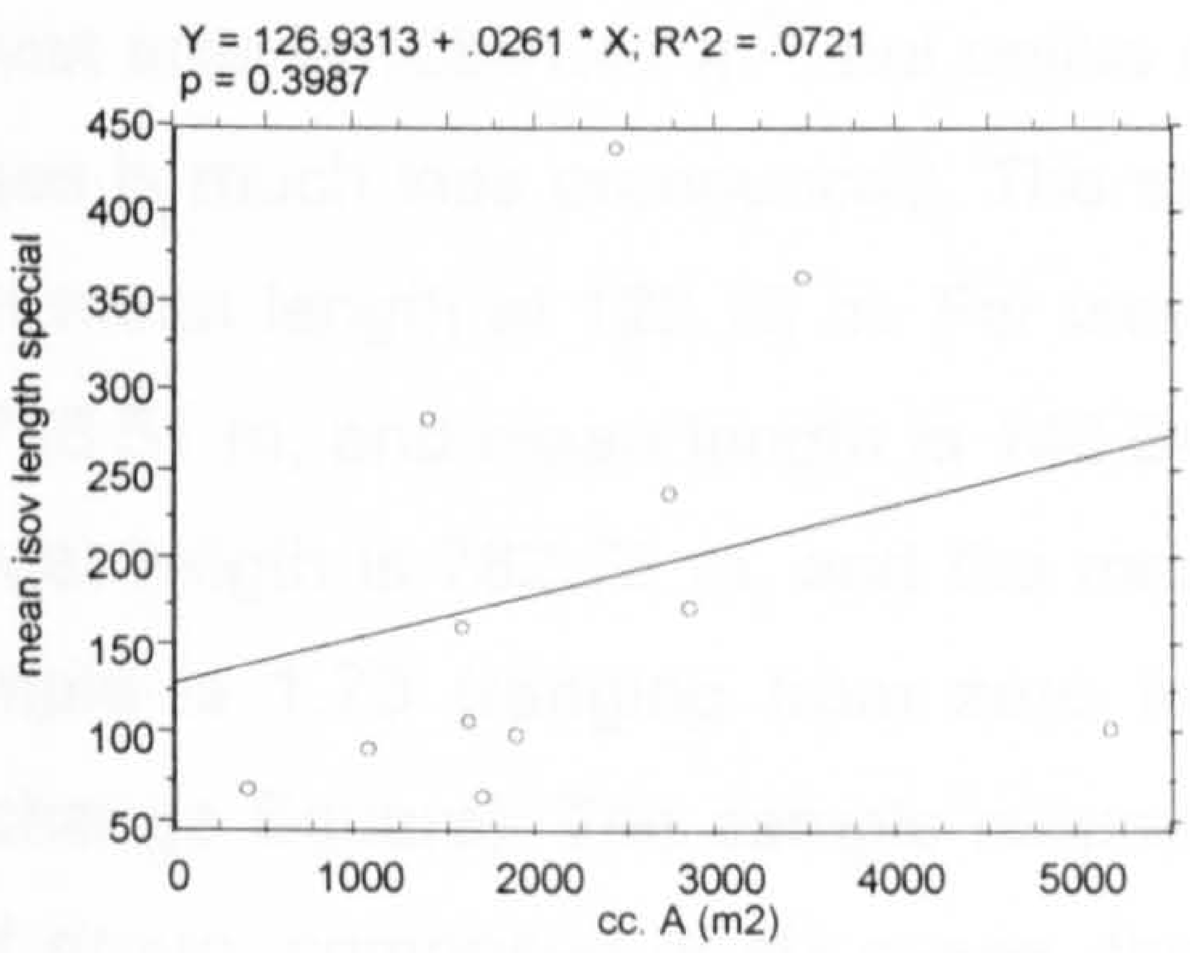

Figure 4.11. Scattergram convex container area and mean of sum of isovist length (special)

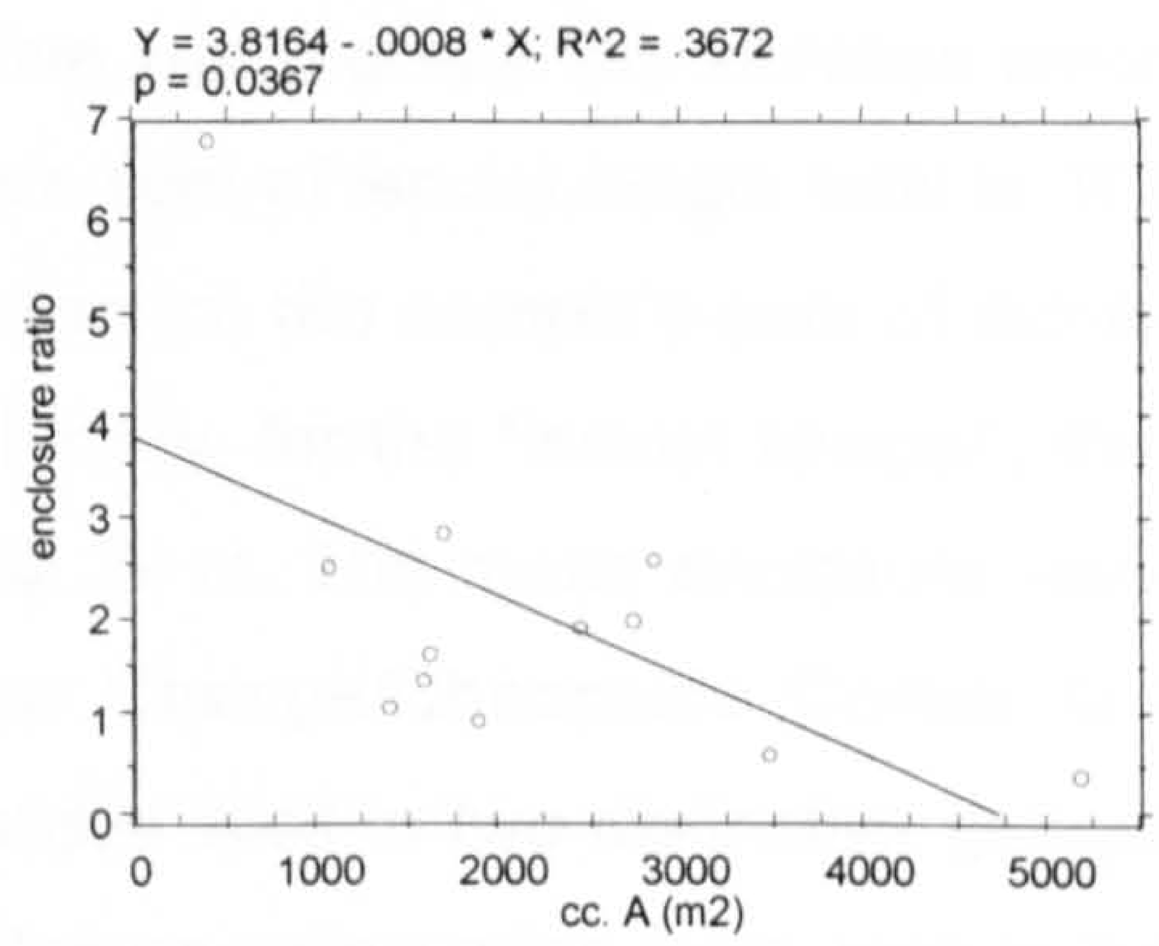

Figure 4.12. Scattergram convex container area and enclosure ratio

N = 12 for all cases

On inspection of the results in Figure 4.12, a negative correlation is shown for the convex container area and the enclosure ratio, ie, the smaller the convex container the more enclosed it is. However, further analysis showed that the top left point is working as an artefact, and in fact there is not an association between the two variables[25].

Convex container representation; results summary:

- The total size of the isovist is only weakly associated to the size of the convex container.
- The sum of isovist length is only weakly associated with size of the convex container for all methods.

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[25] The Kendall rank correlation test results are: Tau corrected for ties = - 0.3030 with p = 0.1702.

- The mean of isovist length is only weakly associated with size of the convex container for all methods.
- The enclosure ratio of the convex container is independent of its size.

4.5.1.2. Effective space representation

An analysis of the effective space sample showed that the mean area for the effective spaces is 1593.41 m^2. Ten out of twelve cases have an effective space area ranging from 322.99 to 1666.82 m^2 with Finsbury Av. (2957.79 m^2) and Exchange Square (6371.41 m^2) having a surface area much larger then the rest of the sample. The mean isovist area is 10851.47 m^2, but unlike effective space areas, the variation amongst the cases is much less pronounced. The sample's sum of isovist length total is 1029.10 m with mean length of 122.75 m. For isovist selected, the sample's sum of isovist length is 756.51 m, and mean length is 140.84 m. Finally, for the "isovist special", the sum of isovist length is 762.78 m, and the mean 152.29 m. The mean enclosure ratio for the sample is 1.73 (ranging from zero for New Change/Cheapside Corner to 3.37 to Exchange Square). The sample naturally divides itself in two distinctive groups. In the first group, composed of six cases, the enclosure ratio varies from zero to 1.16. The remaining 50% of cases have an enclosure ratio between 2.56 and 3.37 (see Table 4.8). The mean visibility ratio for the sample is 13.75, ranging from 1.27 (Exchange Square) to 78.10 (New Change/Cheapside Corner) but with eleven cases between 1.27 and 19.57. The visibility ratio for New Change/Cheapside Corner is a unique case that can be explained by its distinct location at the junction of two major roads (New Change and Cheapside) of exceptional length and width in comparison to the others in the City of London. The sample showed four cases (Bank, Fenchurch Place, St. Anne/St. Agnes Churchyard and Whittington Gardens) where the amount of unbuilt perimeter prevailed against the built perimeter and there is one case, New Change/Cheapside Corner, which is completely detached from building walls.

As before, this initial numerical investigation was followed by correlation analysis, to see if there is a relationship between the area of effective spaces and isovist area and lengths, as illustrated in Figures 4.13 to 4.16.

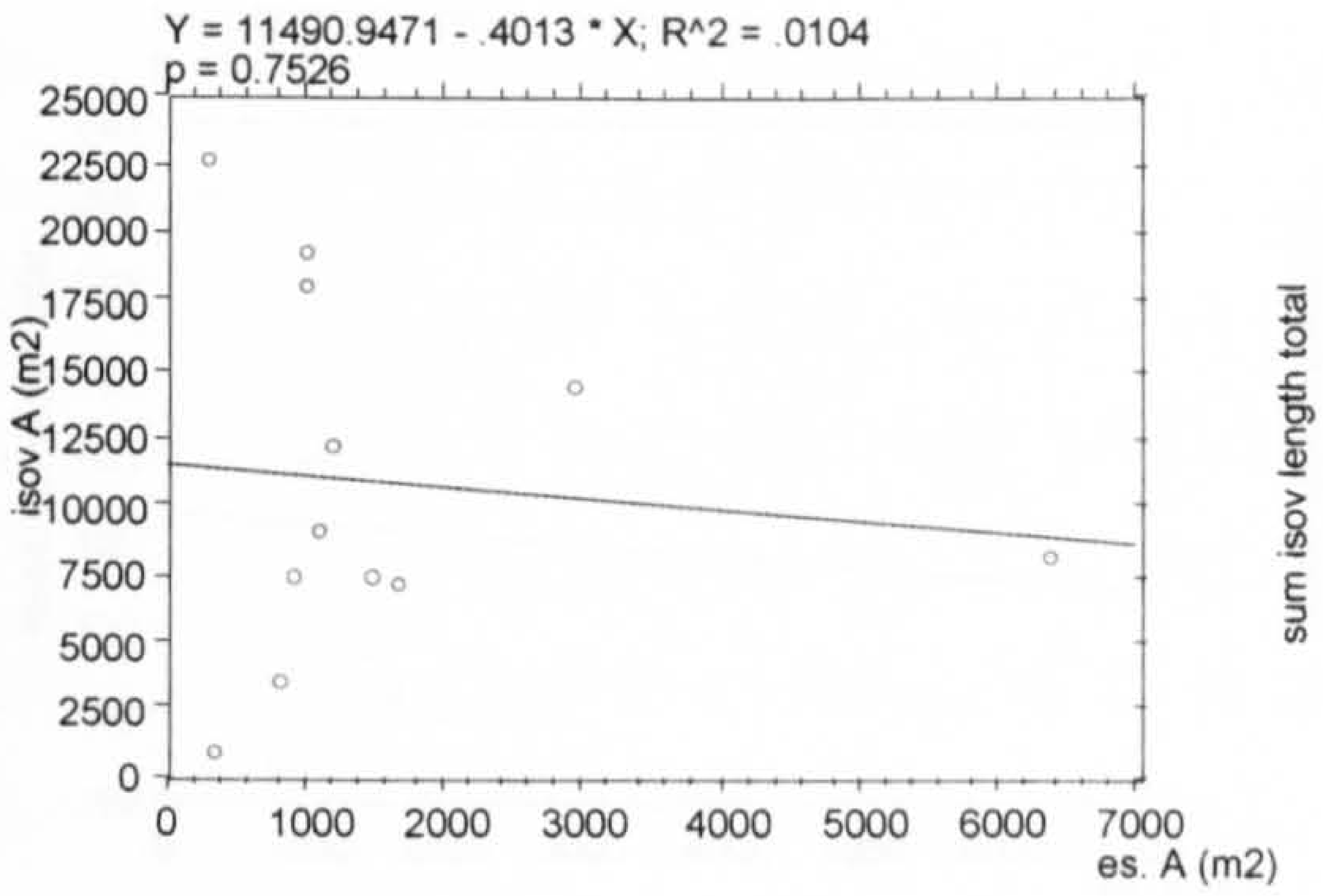

Figure 4.13. Scattergram effective space area and convex isovist area

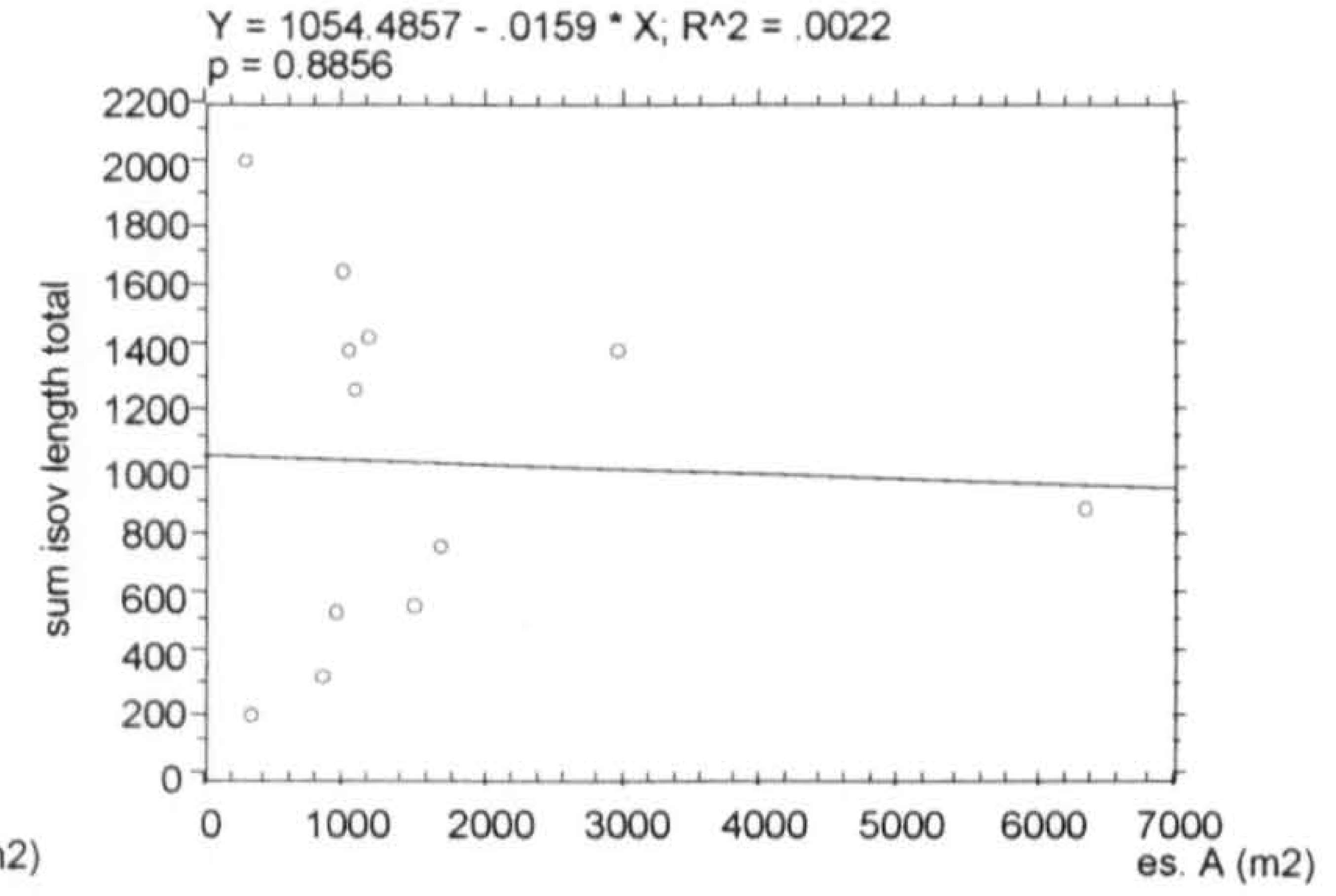

Figure 4.14. Scattergram effective space area and sum of isovist length (total)

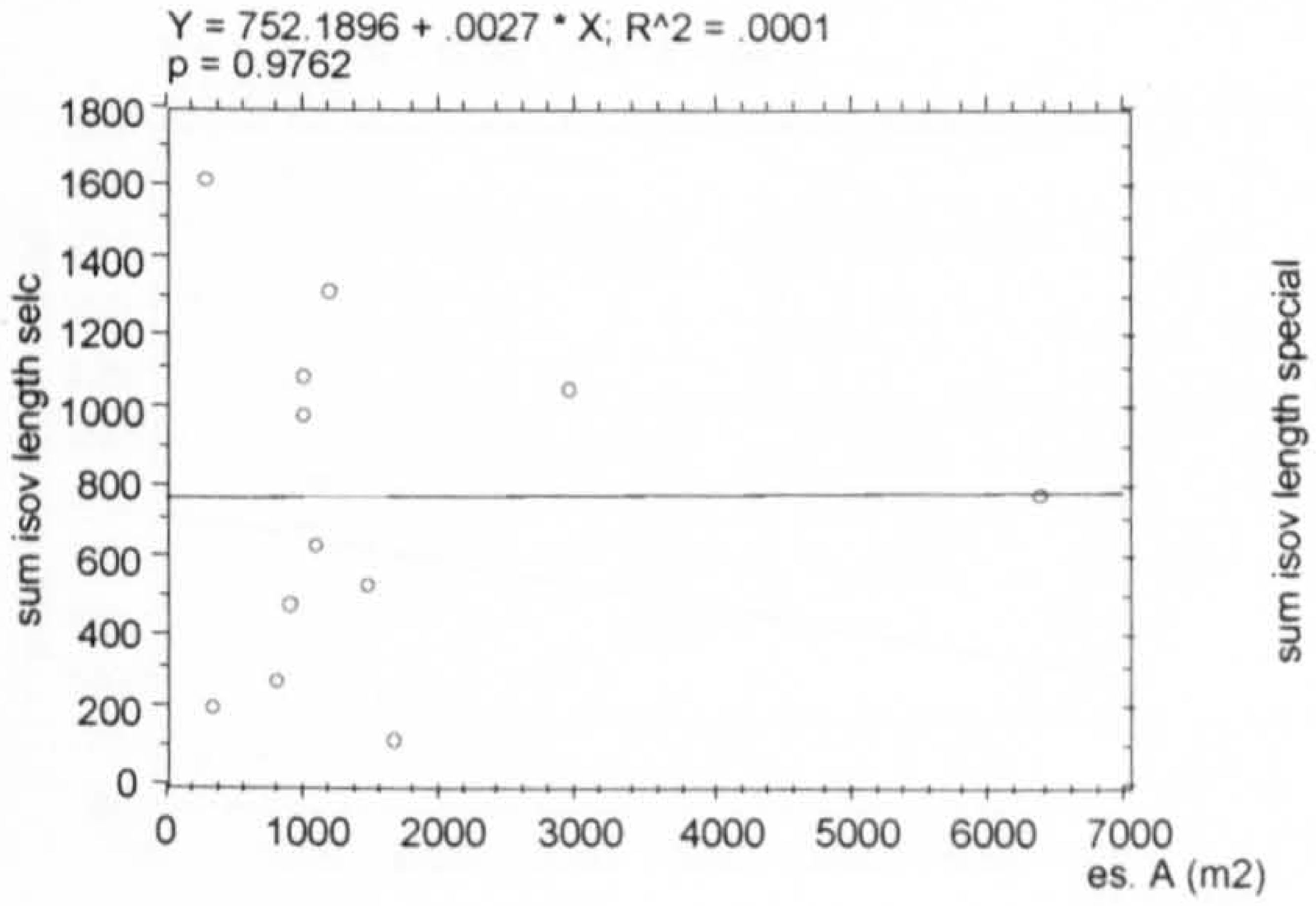

Figure 4.15. Scattergram effective space area and sum of isovist length (selected)

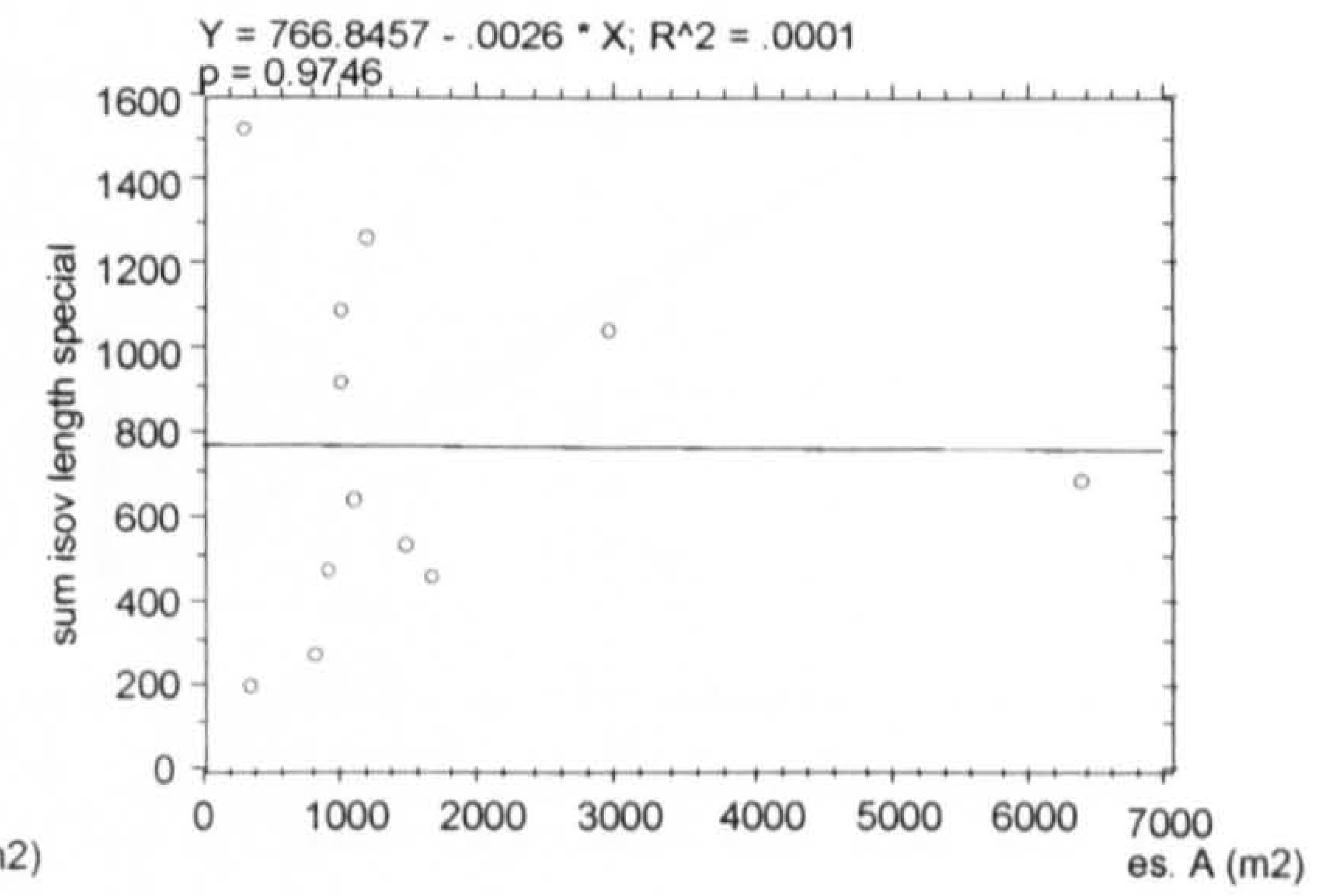

Figure 4.16. Scattergram effective space and sum of isovist length (special)

N = 12 for all cases

Unlike the finding for the convex container representation, the scattergrams show that while the size of effective spaces is limited to a relatively small range (300 – 2000 m^2), the size and sum of isovist lengths are not, showing that these two parameters have an independent relationship. Likewise, the relationship between the area of the effective space and the mean of isovist length showed independent for all three methods used (Figs. 4.17 to 4.19). Similarly, no correlation was found for enclosure ratio and the size of effective spaces, as shown in Figure 4.20, next.

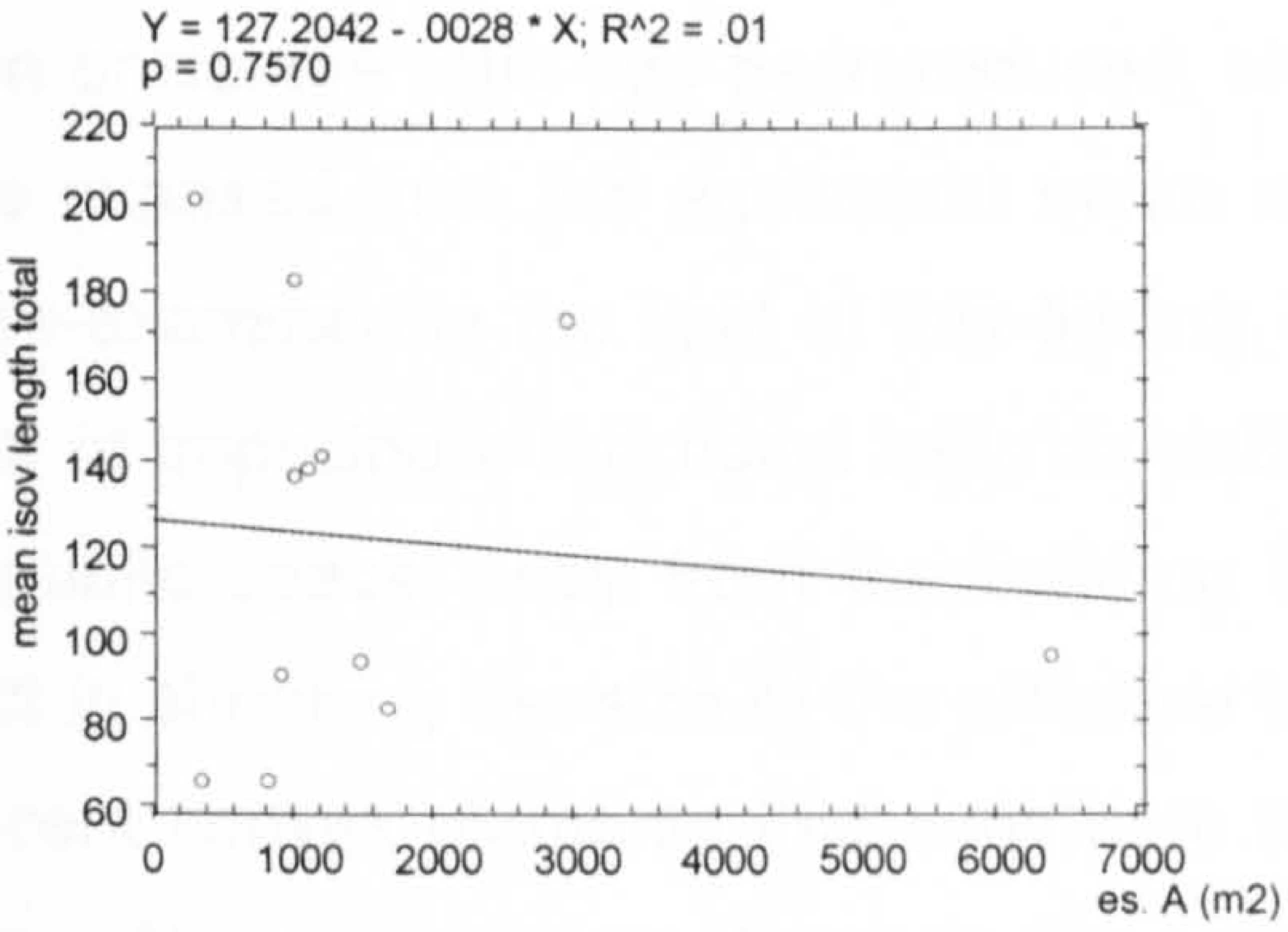

Figure 4.17. Scattergram effective space area and mean of sum of isovist length (total)

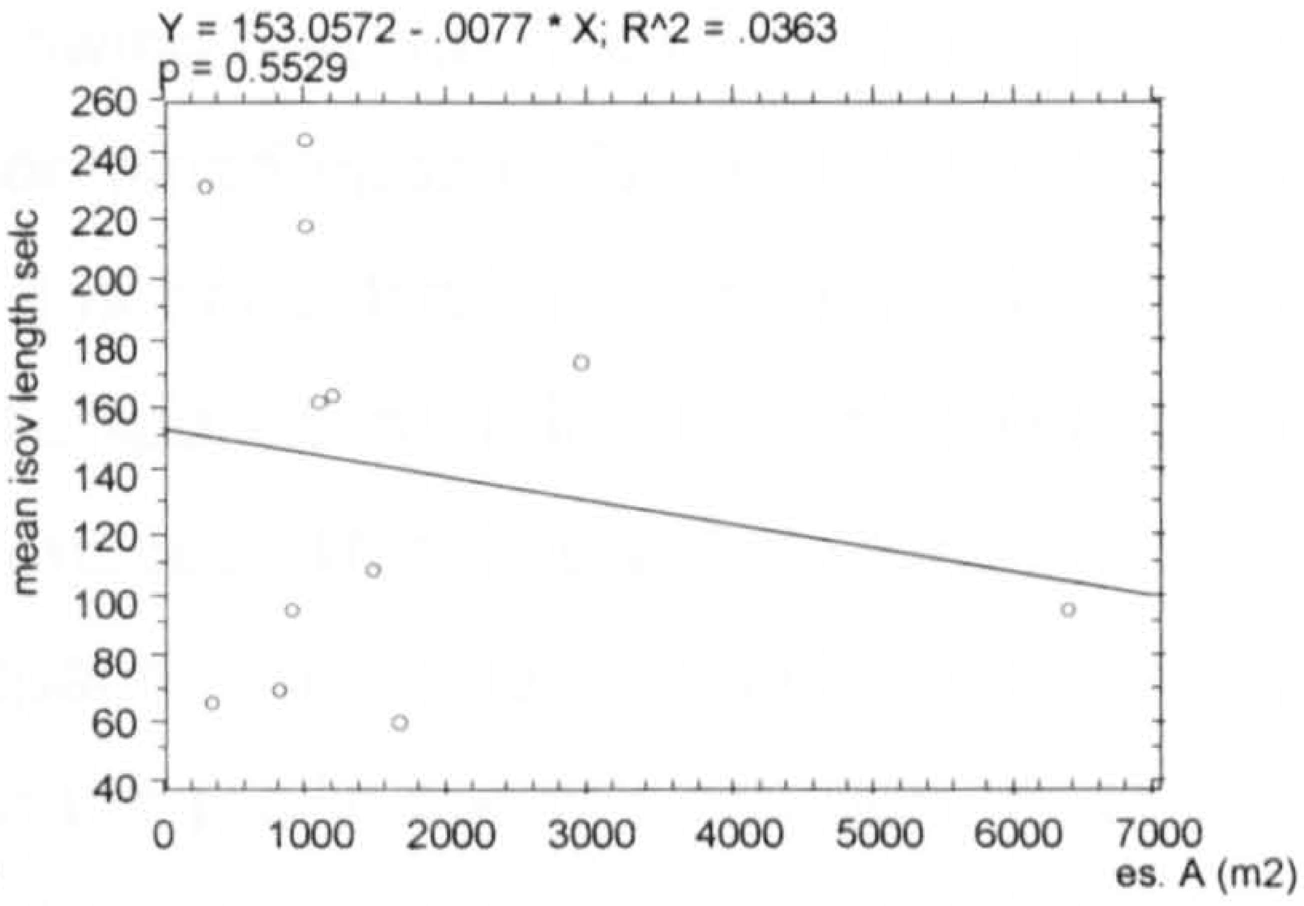

Figure 4.18. Scattergram effective space area and mean of sum of isovist length (selected)

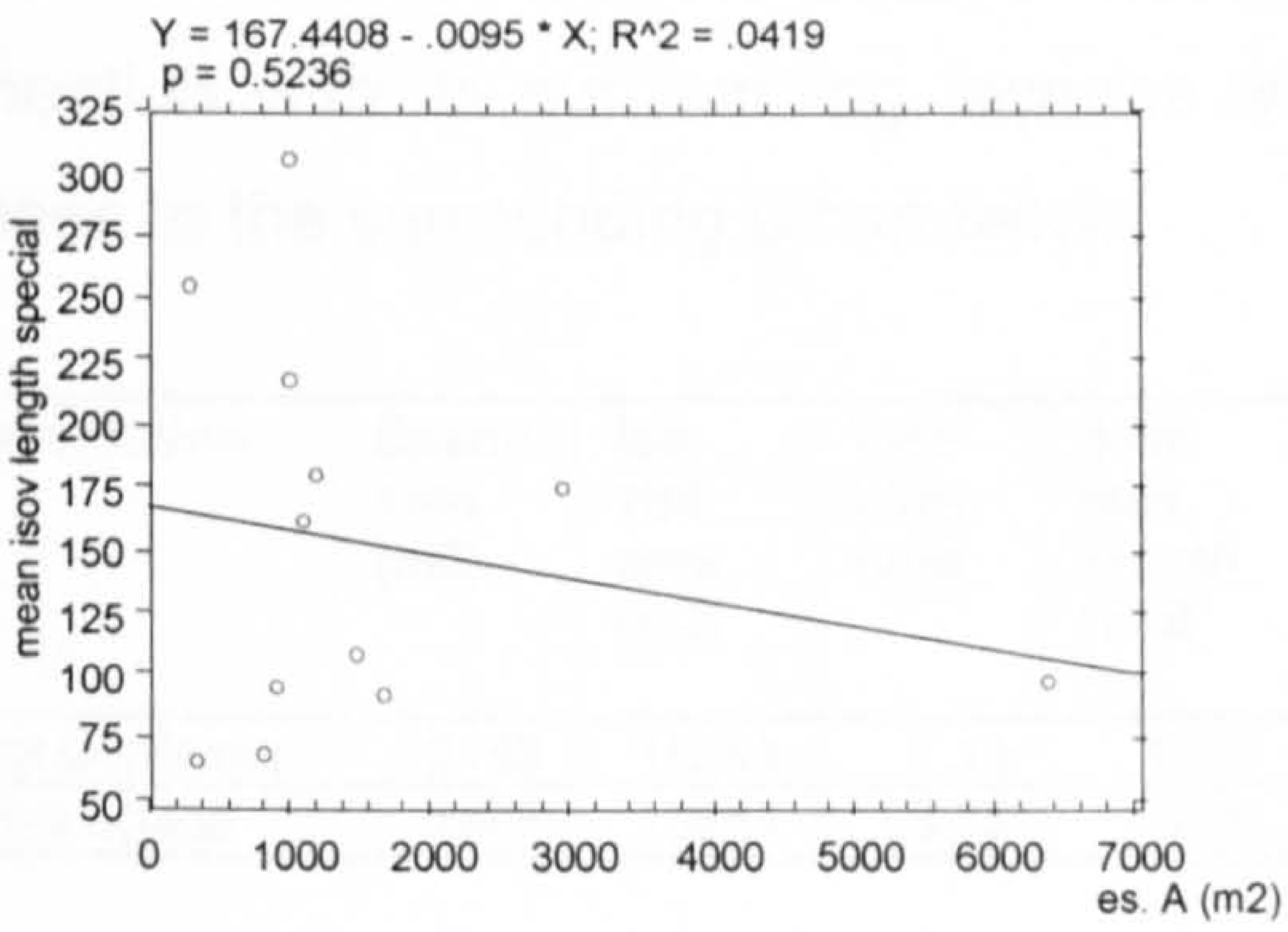

Figure 4.19. Scattergram effective space area and mean of sum of isovist length (special)

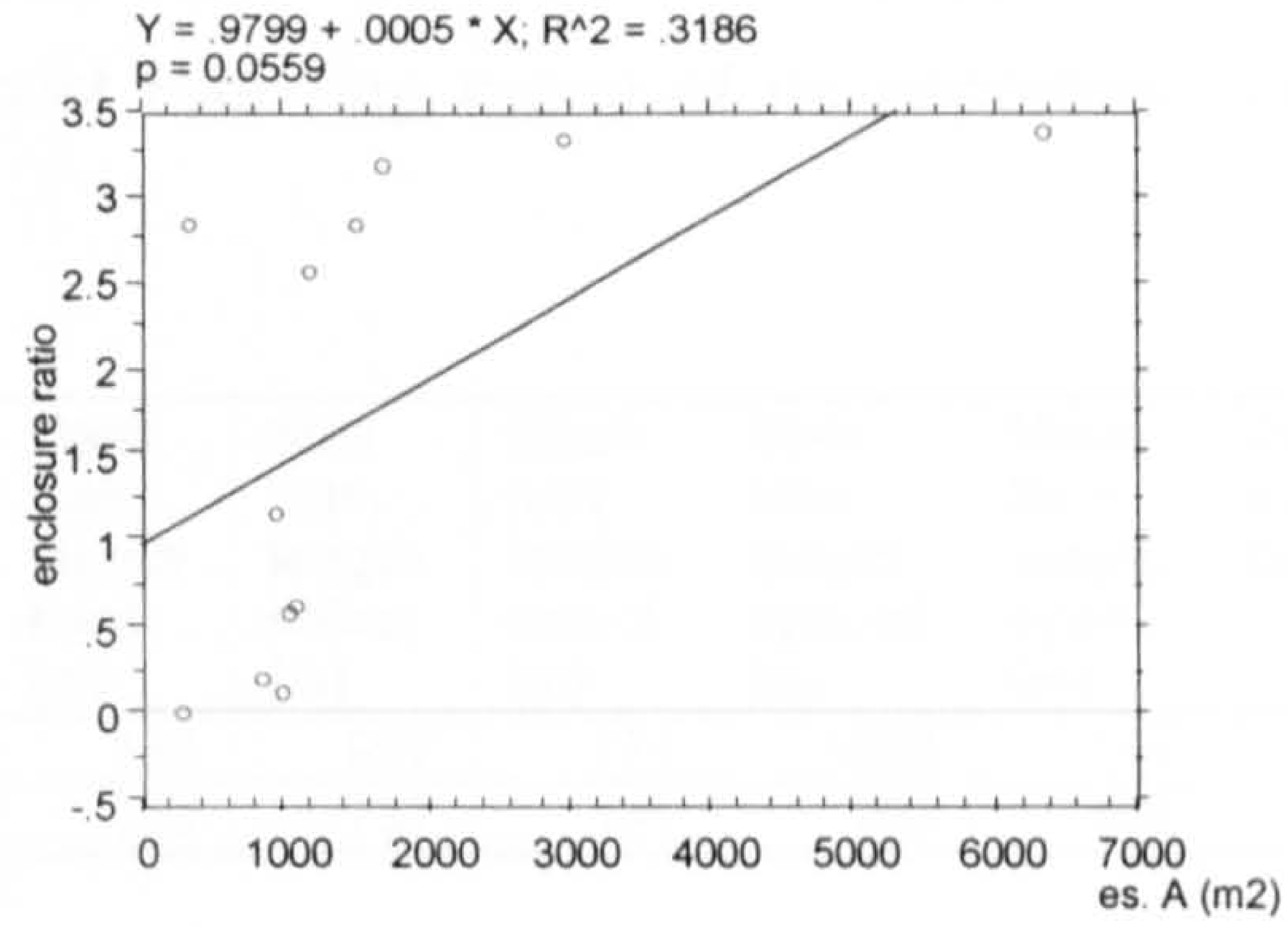

Figure 4.20. Scattergram effective space area and enclosure ratio

N = 12 for all cases

Effective space representation; results summary:

- The total size of the isovist is independent of the size of the effective space.
- The sum of isovist length is independent of the size of the effective space for all methods.
- The mean isovist length is independent of the size of the effective space for all methods.
- The enclosure ratio of the effective space is independent of its size.

4.5.1.3. Comparing convex container and effective space representations

A comparison of convex and isovist values between the convex container and effective space representations (Table 4.9) shows that the tendency to separate roadways and public spaces from pavements (to assign specific uses to parts of public space and to delineate these by hard and soft landscaping) has resulted in a consistent lowering of all the mean values except for the visibility ratio, which has actually doubled. Also, the mean enclosure ratio has been reduced, showing that the mean effective space is far more exposed than the equivalent mean contained space. Once Plates 4.13 to 4.16 are re-examined in the light of this finding, it is not difficult to see why. The dominant effect of imposing a functional logic on public spaces is to draw the effective space of the public space away from the building façades. This has a far more pronounced effect in shrinking the size of the effective space than the process of incorporating the adjacent convex elements that contribute to the public space's function as an activity setting. At the same time, because the shrinkage tends to occur towards the centre of the convex container, the effect on the shape and extent of the isovist is less pronounced. The "effective square" becomes more exposed as it loses its convex connection with its surrounding façades whilst retaining many of its important linear linkages to the surrounding urban fabric.

Representation	Space area (m2)	Iso-vist area (m2)	Visi-bility ratio	Sum isov. length total (m)	Mean isov. length total (m)	Sum isov. length select (m)	Mean isov. length select (m)	Sum isov. length special (m)	Mean isov. length spec. (m)	Enclo sure ratio
Convex Container	2188	15248	7.13	1362	144	937	174	1028	184	2.05
Effective Space	1593	10851	13.75	1029	123	757	141	763	152	1.73

Table 4.9. Convex and isovist analysis comparative measures

Comparing the results of the regression analysis for the convex container and effective space, the main finding is the loss, in the effective space representation, of the relationship between the size of the public space and the respective isovists properties (being either the area or length, whichever method is used for its quantification). These findings reinforce the suggestion that for the effective space representation, although containing smaller areas, the visual connections do retain their original dimensions.

4.5.2. INTERFACING AXIAL LINES ANALYSIS

The next stage investigates the local spatial properties of axial lines for the two models of representation. The section starts with a description of the distribution of axial lines which interface with the public space according to types (convergent, transverse or peripheric) and according to intersection points. The analysis proceeds by focusing on the relationship between axial lines (number, length, integration, strategic values, and intersection points) and the area of public spaces, and lastly with area of isovists. The data used in the analysis is illustrated in Tables 4.10 (convex container representation) and 4.11 (effective space representation), next.

Names	Sum axial lines length	Mean sum ax.lines length	N° (C) axial lines	N° (T) axial lines	N° (P) axial lines	N° all axial lines	Sum R3 (C) axial lines	Sum R3 (T) axial lines	Sum R3 (P) axial lines
Abchuchyard	251.41	125.71	1	•	1	2	1.48	•	4.03
Bank Corner	2184.61	728.20	•	•	3	3	•	•	16.28
Exchange Sq.	1410.84	201.55	5	1	1	7	16.84	3.53	2.81
Fenchurch Pl.	539.44	134.86	4	•	•	4	11.84	•	•
Finsbury Av.	964.16	192.83	5	•	•	5	15.60	•	•
Fleet Place	605.34	201.78	•	2	1	3	•	6.85	3.54
Love Lane	651.72	162.93	3	1	•	4	8.84	3.50	0.00
New Change	2853.41	407.63	4	2	1	7	18.09	8.88	5.82
North Guildhall	371.02	185.51	1	1	•	2	2.87	3.00	•
Royal Exch.	2609.32	434.89	2	1	3	6	7.39	3.41	16.28
St Anne	995.89	331.96	1	•	2	3	4.38	•	7.80
Whittington Gs.	1520.68	380.17	3	•	1	4	9.86	•	5.61

Names	Local strategic value	Sum Rn (C) axial lines	Sum Rn (T) axial lines	Sum Rn (P) axial lines	Strategic value	Rn value main line	Total n° intersection points	2 axial lines/ point	3 axial lines/ point
Abchuchyard	5.51	1.27	•	1.46	2.73	1.4611	1	1	•
Bank Corner	16.28	•	•	4.63	4.63	1.5549	1	1	•
Exchange Sq.	23.18	5.93	1.15	1.16	8.24	1.2417	8	7	1
Fenchurch Pl.	11.84	4.95	•	•	4.95	1.2582	4	3	1
Finsbury Av.	15.60	6.02	•	•	6.02	1.2790	4	2	2
Fleet Place	10.39	•	2.71	1.37	4.08	1.3870	2	2	•
Love Lane	12.34	3.64	1.32	•	4.96	1.3212	4	4	•
New Change	32.79	5.81	2.88	1.51	10.20	1.5507	12	10	2
N. Guildhall	5.87	1.25	1.19	•	2.44	1.2523	1	1	•
Royal Exch.	27.08	2.76	1.37	4.63	8.76	1.5549	4	3	1
St Anne	12.18	1.41	•	2.71	4.12	1.4063	2	2	•
Whittington Gs.	15.47	3.99	•	1.44	5.43	1.4400	4	4	•

Table 4.10. Convex container representation interfacing axial lines analysis data

Names	Sum axial lines length	Mean sum ax.lines length	N° (C) axial lines	N° (T) axial lines	N° (P) axial lines	N° all axial lines	Sum R3 (C) axial lines	Sum R3 (T) axial lines	Sum R3 (P) axial lines
Abchuchyard	51.26	51.26	•	1	•	1	•	1.48	•
Bank Corner	771.32	385.66	1	1	•	2	5.51	3.43	•
Exchange Sq.	1244.86	207.48	4	1	1	6	13.30	3.36	2.61
Fenchurch Pl.	317.32	158.66	•	1	1	2	•	2.72	3.21
Finsbury Av.	964.16	192.83	5	•	•	5	15.59	•	•
Fleet Place	605.34	201.78	•	1	2	3	•	3.60	6.79
Love Lane	336.84	168.42	1	1	•	2	2.72	3.52	•
New Change	456.45	228.23	•	2	•	2	•	7.82	•
North Guildhall	361.25	180.62	1	1	•	2	2.84	2.72	•
Royal Exch.	424.72	141.57	1	2	•	3	3.46	7.46	•
St Anne	410.07	205.04	1	1	•	2	4.57	2.87	•
Whittington Gs.	195.27	195.27	•	•	1	1	•	•	3.94

Names	Local strat. value	Sum Rn (C) axial lines	Sum Rn (T) axial lines	Sum Rn (P) axial lines	Strategic value	Rn value main line	Total n° intersec. points	2 axial lines/ point	3 axial lines/ point
Abchuchyard	1.48	•	1.27	•	1.27	1.2742	•	•	•
Bank Corner	8.93	1.55	1.40	•	2.95	1.5526	1	1	•
Exchange Sq.	19.27	4.78	1.15	1.16	7.09	1.2425	7	6	1
Fenchurch Pl.	5.93	•	1.17	1.26	2.43	1.2638	1	1	•
Finsbury Av.	15.59	6.02	•	•	6.02	1.2796	4	2	2
Fleet Place	10.39	•	1.39	2.69	4.08	1.3880	•	•	•
Love Lane	6.24	1.19	1.32	•	2.51	1.3223	1	1	•
New Change	7.82	•	2.72	•	2.72	1.4077	1	1	•
N. Guildhall	5.55	1.25	1.19	•	2.44	1.2532	1	1	•
Royal Exch.	10.91	1.37	2.77	•	4.13	1.3967	1	•	1
St Anne	7.44	1.41	1.27	•	2.68	1.4077	1	1	•
Whittington Gs.	3.94	•	•	1.39	1.39	1.3869	•	•	•

Table 4.11. Effective space representation interfacing axial lines analysis data

4.5.2.1. Convex container representation

The analysis showed a total number of 50 axial lines, with a mean of 4.17 axial lines interfacing with the convex container. Convergent axial lines represent the majority with 58% of all cases, followed by peripheric with 26% and transverse with the remaining 16%. However, looking at the frequency distribution of the different types of axial lines, convergent axial lines are present in ten cases, peripheric in eight and transverse in six cases only. The mean length of the axial lines is 299.16 m, where transverse (mean of 191.31 m) and convergent (199.40 m) axial lines tend to be shorter in contrast to peripheric ones (588.07 m).

The total number of intersection points identified was 47, 85% of them were composed of 2 intersecting axial lines. The remaining 15% consisted of an intersection of 3 or more axial lines with only one case of 4 lines intersecting at one point (New Change/Cheapside Corner - Fig. 8, Plate 4.17). The mean number of intersection points per convex container is 3.9, ranging from 1 to 12. For the intersections of 2 axial lines, comprising the majority of the sample, there is a mean of 3.33 intersection points per convex container. If we consider 3 or more axial lines, there is a sharp decrease with 7 intersection points in five convex container cases. Focusing on the location of the intersection points, the results showed that there is a tendency for the intersection points to be located at the edge of the convex container (77% of the cases). The analysis also showed (as in the study of traditional urban squares) that axial lines of one type (convergent, transitional or peripheric) were not restricted to intersecting with the same type group, or at specific locations.

Despite the relatively high number of axial lines interfacing with the convex container, the predominance of convergent axial lines reflects the relationship between the area of the convex element and axial lines, which showed very distinctive results according to the type of properties investigated. The analysis between the area of the convex container and the total number of axial lines showed a good linear correlation (Fig. 4.21). However, when analysing the influence of axial line character in relation to the size of the convex container, the low number of transverse and peripheric axial lines makes the interpretation of results difficult. Clearly, a positive correlation was shown only for convergent ones (Figs. 4.22 to 4.24).

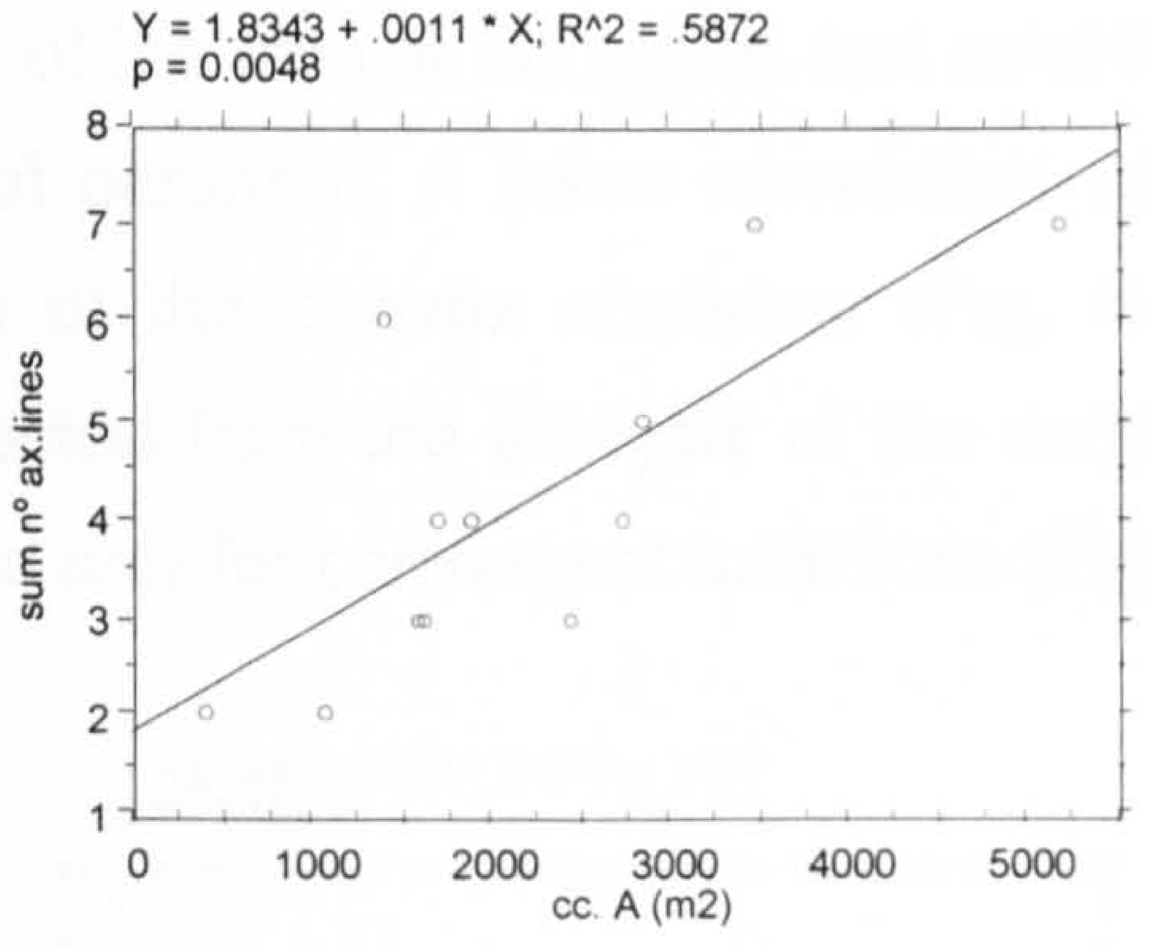

Figure 4.21. Scattergram convex container area and sum of number of axial lines, n = 12

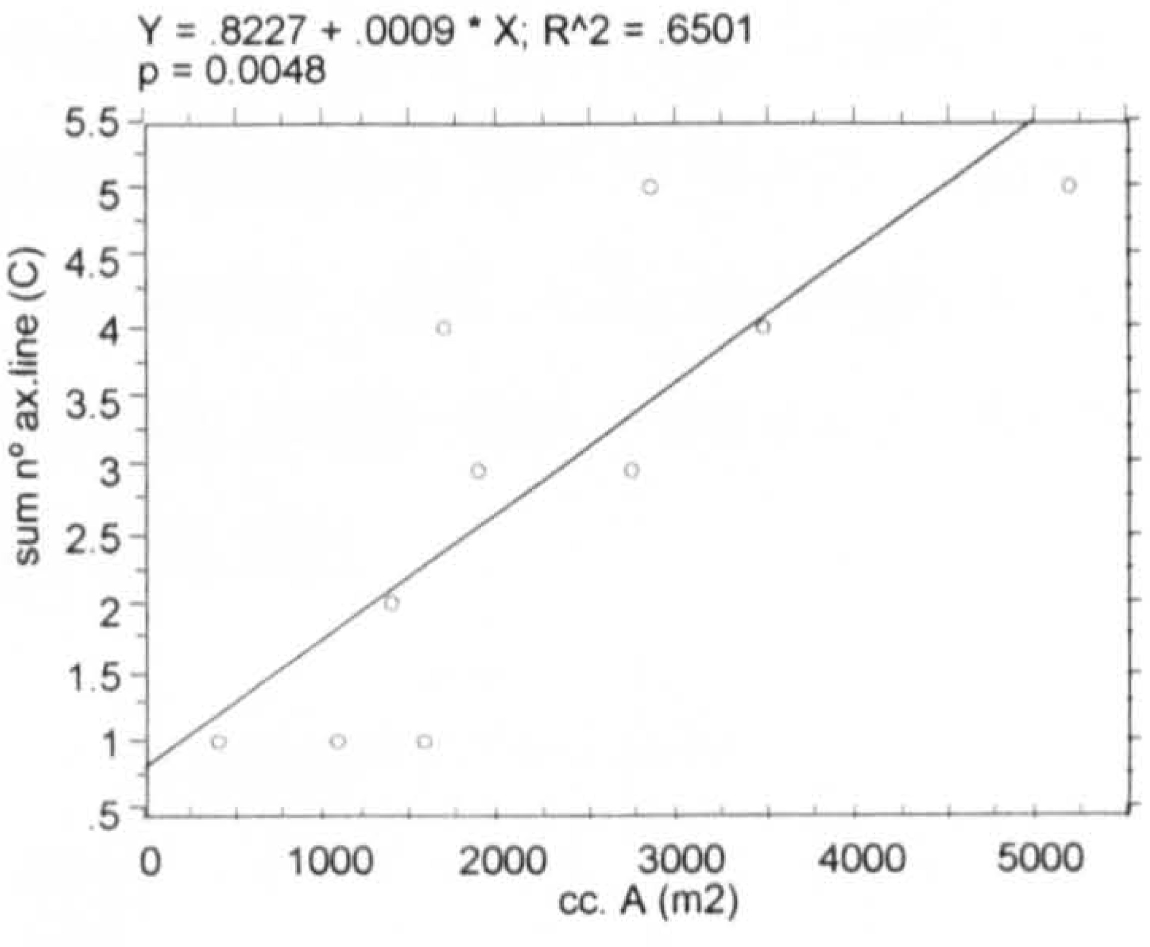

Figure 4.22. Scattergram convex container area and sum of number of C axial lines, n = 10

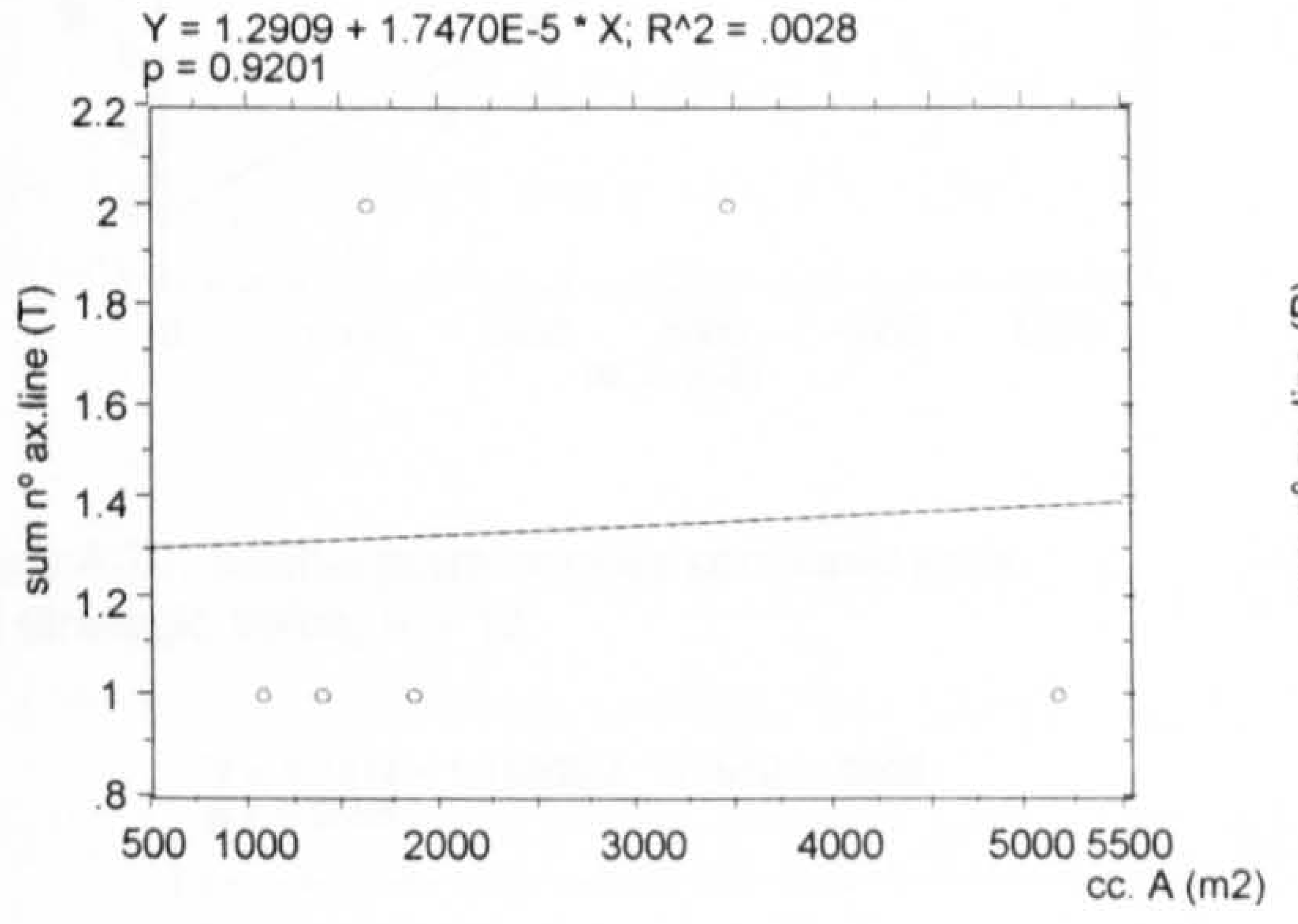

Figure 4.23. Scattergram convex container area and sum of number of T axial lines, n = 6

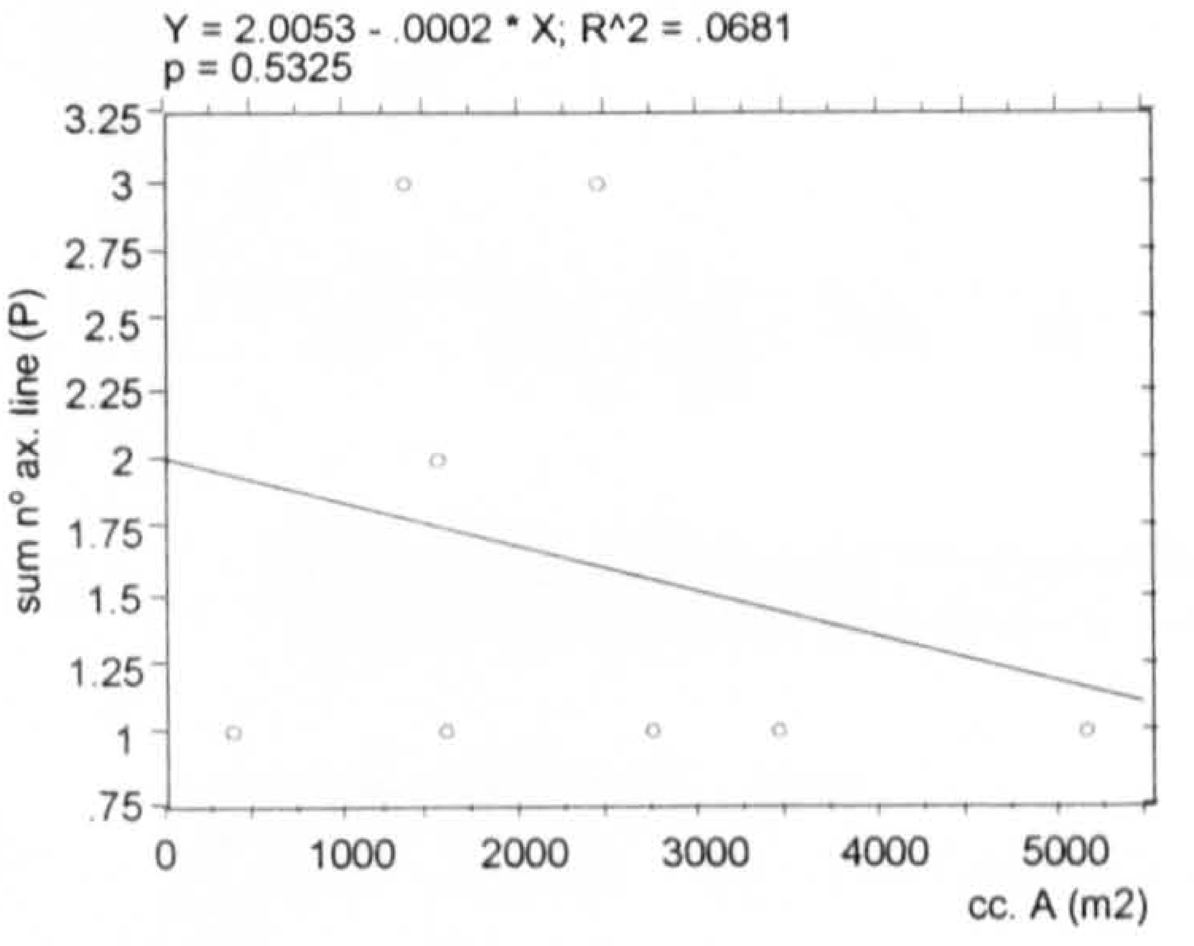

Figure 4.24. Scattergram convex container area and sum of number of P axial lines, n = 8

Looking at the metric properties, the results suggest that the length of the axial lines have little relationship to the areas of respective convex containers. Only a weak correlation was found for the sum of the length of the axial lines (Fig. 4.25) and no correlation was found for the mean length of the axial lines (Fig. 4.26).

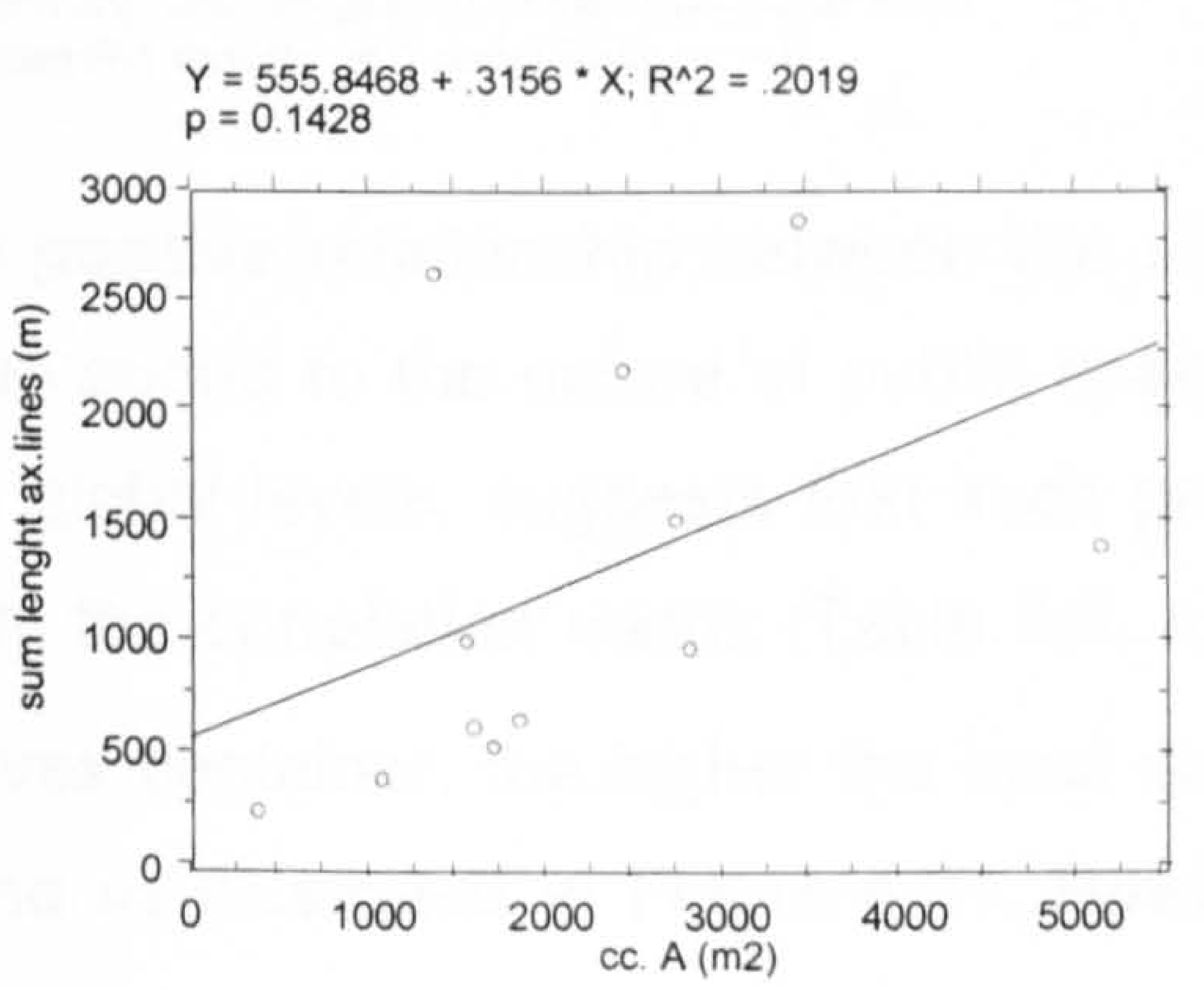

Figure 4.25. Scattergram convex container area and sum of the length of axial lines

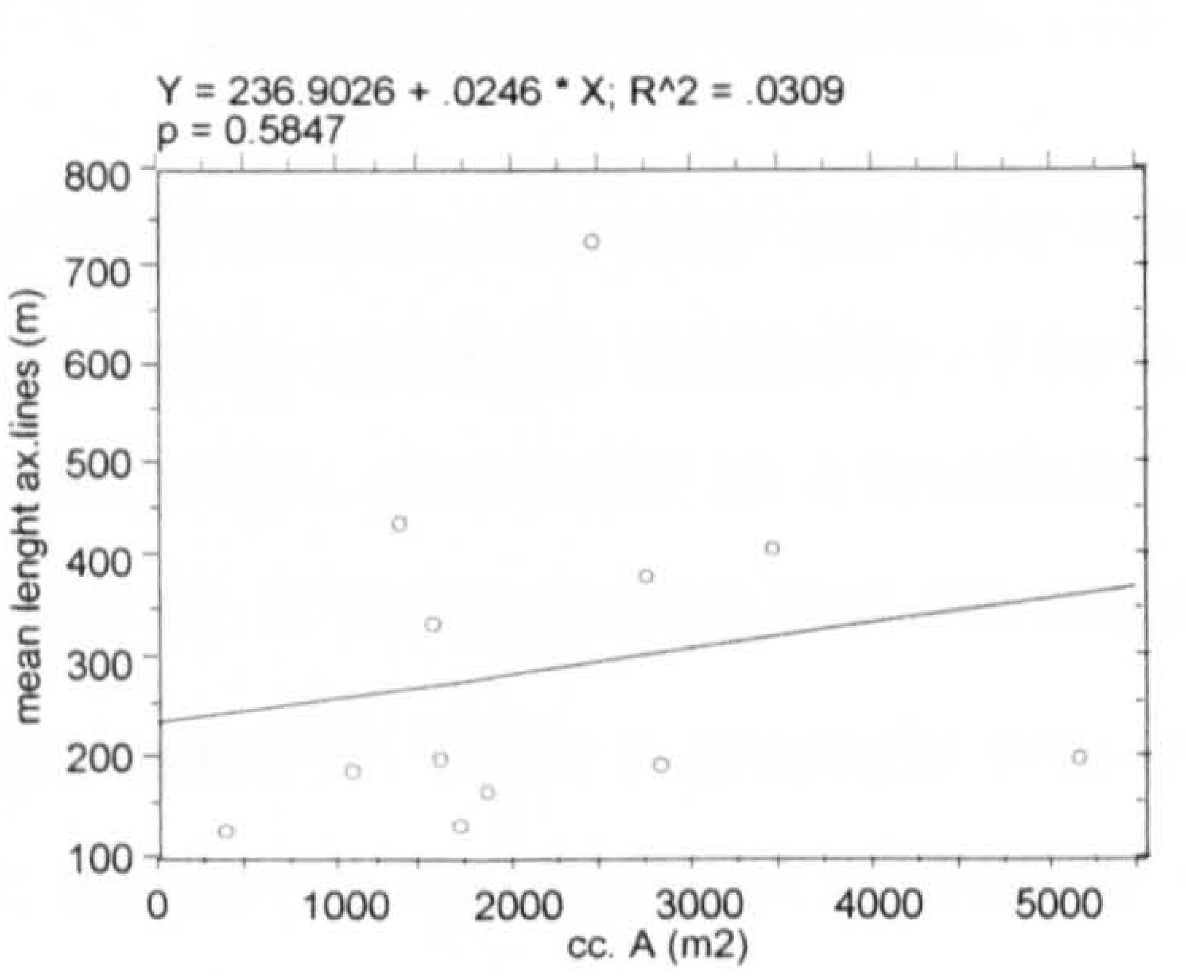

Figure 4.26. Scattergram convex container area and mean of sum of the length of axial lines

For the syntactic properties, the study confirms that for the relationship between the area of the convex container and axial lines, the distinction between types of axial lines is not pertinent. A linear correlation was found between the strategic value and the area of the convex container (Fig. 4.27). However, the scattergrams showed, as expected from the analysis of the number of axial lines, that a linear correlation was found only for convergent axial lines (Figs. 4.28 to 4.30).

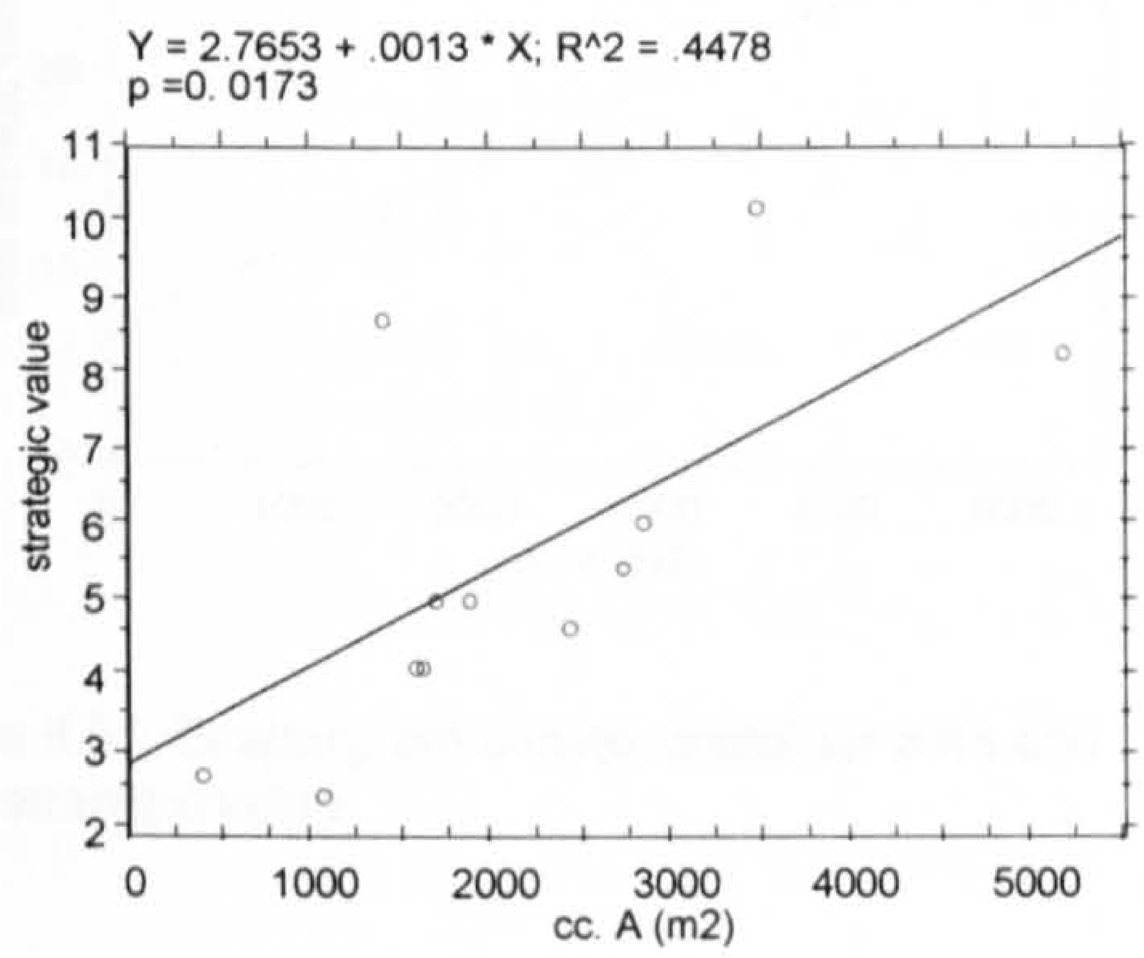

Figure 4.27. Scattergram convex container area and strategic value, n = 12

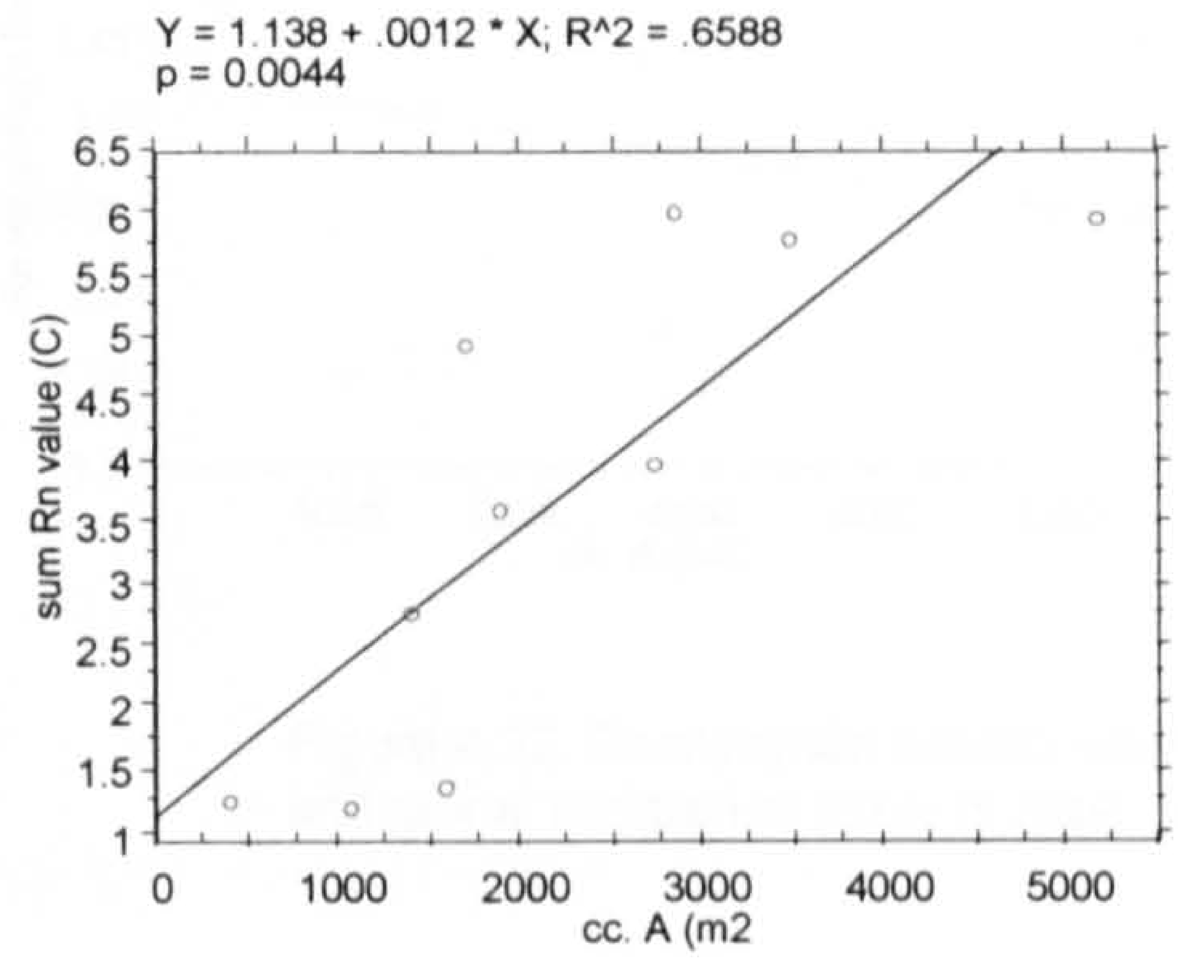

Figure 4.28. Scattergram convex container area and sum Rn values of C axial lines, n = 10

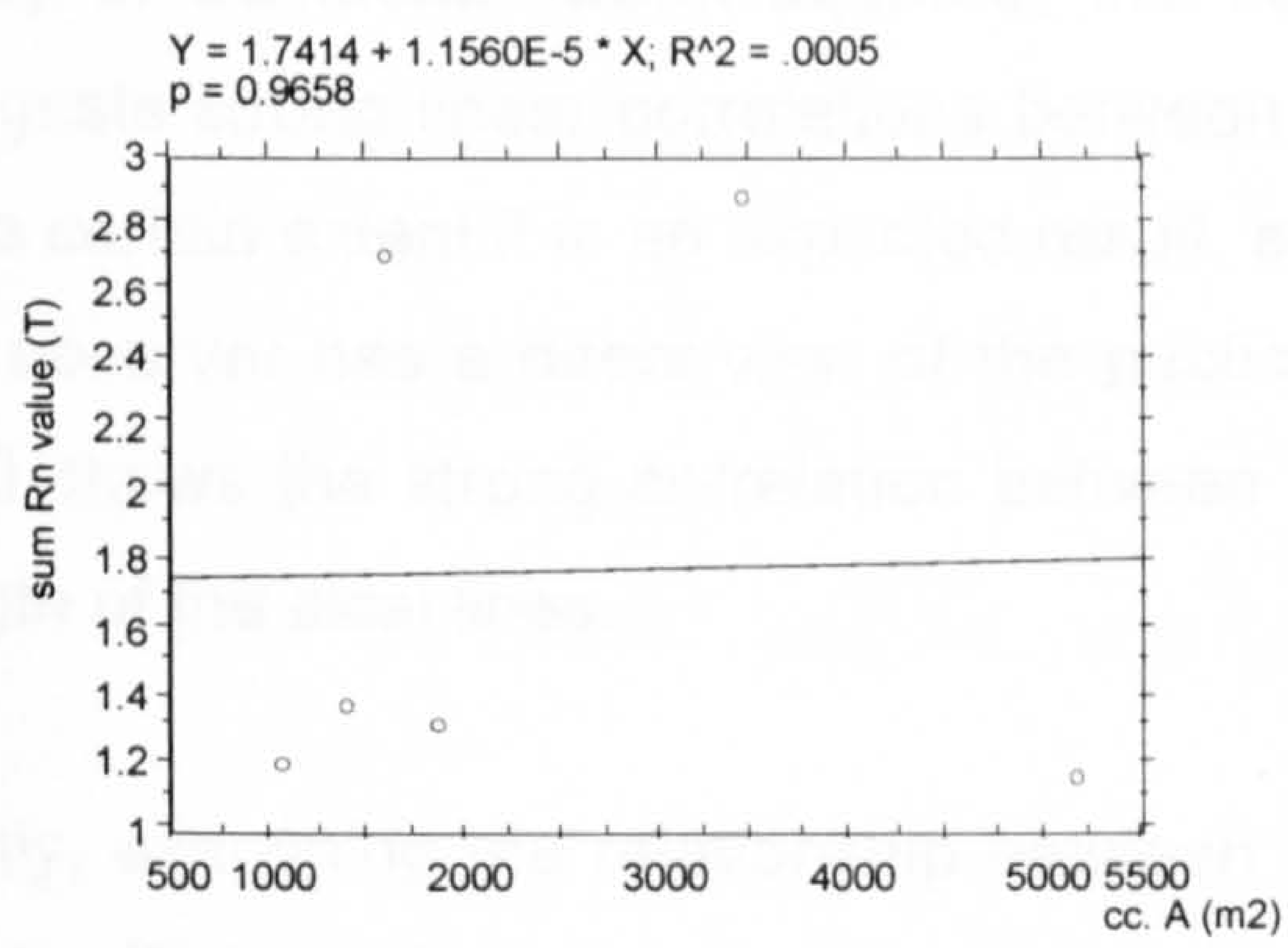

Figure 4.29. Scattergram convex container area and sum Rn values of T axial lines, n = 6

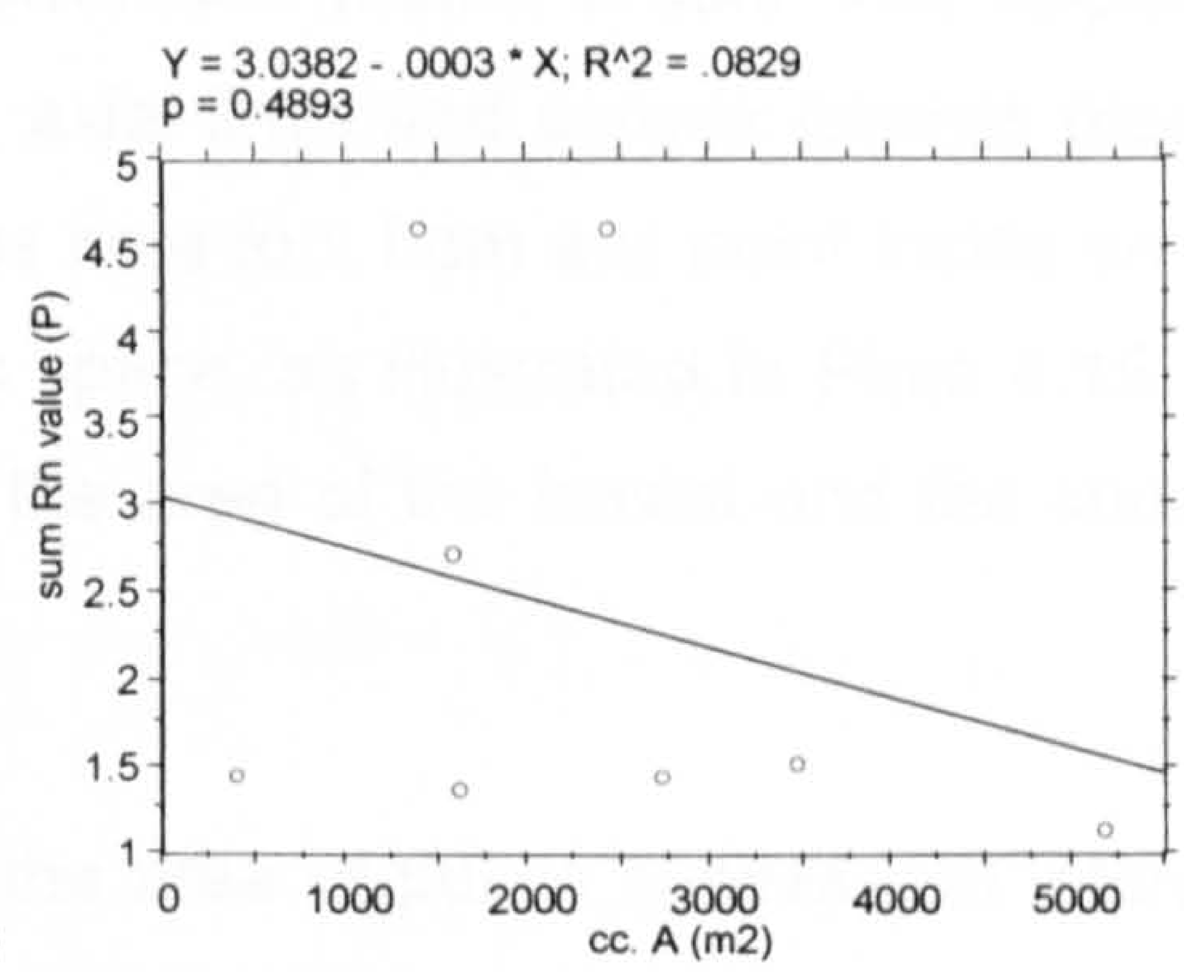

Figure 4.30. Scattergram convex container area and sum Rn values of P axial lines, n = 8

The positive relationship between the size of the convex container and the strategic value added to the nature of public spaces, ie, being strategic elements at both local and global levels, suggests that such properties might also exist at a localised level. From the correlation matrix (Table 4.5, appendix 2), it is suggested that the larger the convex container, the higher the local strategic value[26]. Such a property was indeed found as illustrated in Figure 4.31. However, similar to the study of traditional urban

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[26] The local strategic value is defined by the sum of radius-3 integration values of all the axial lines that interface with the convex container or effective space representations. Refer to Chapter 3.

squares, no correlation was found for the global integration value of the main line that crosses the convex container and its area (Fig. 4.32).

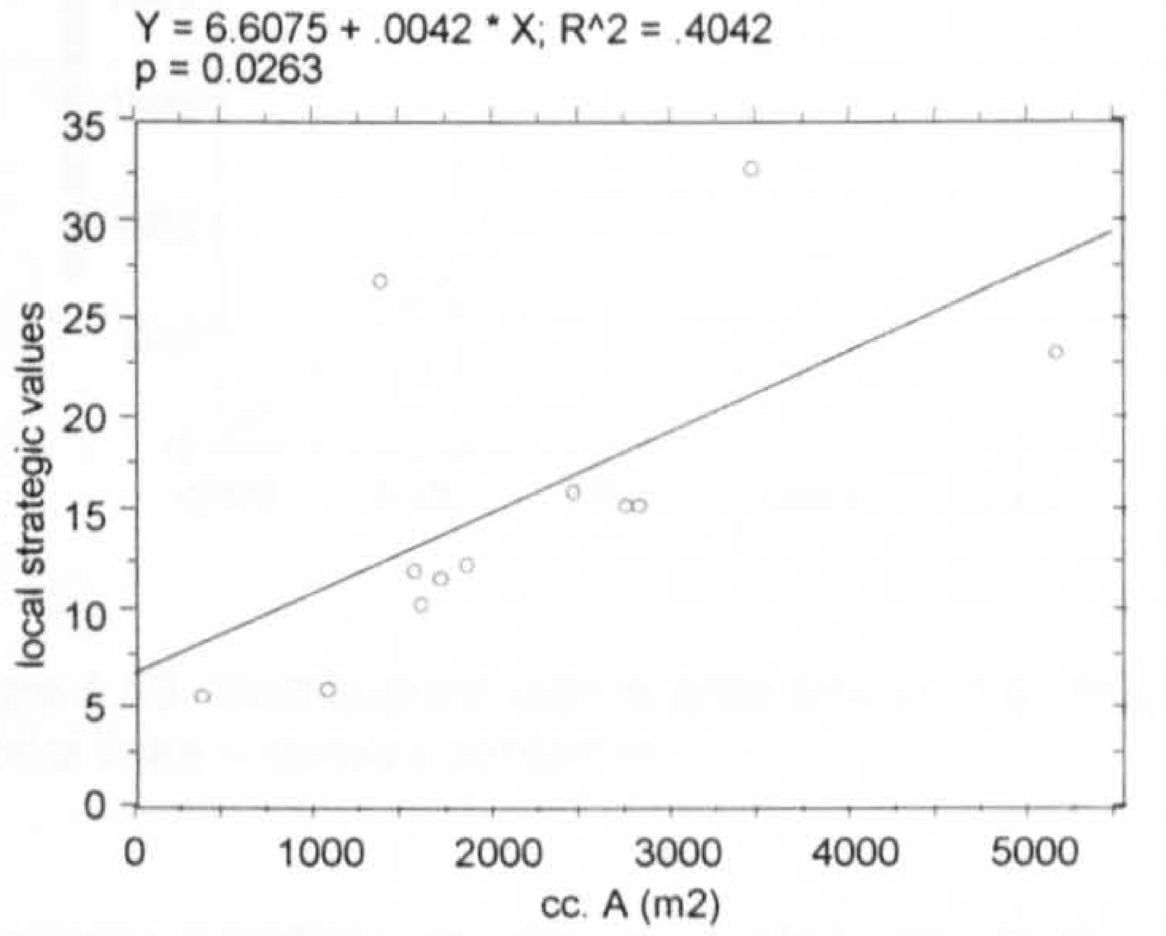

Figure 4.31. Scattergram convex container area and local strategic value

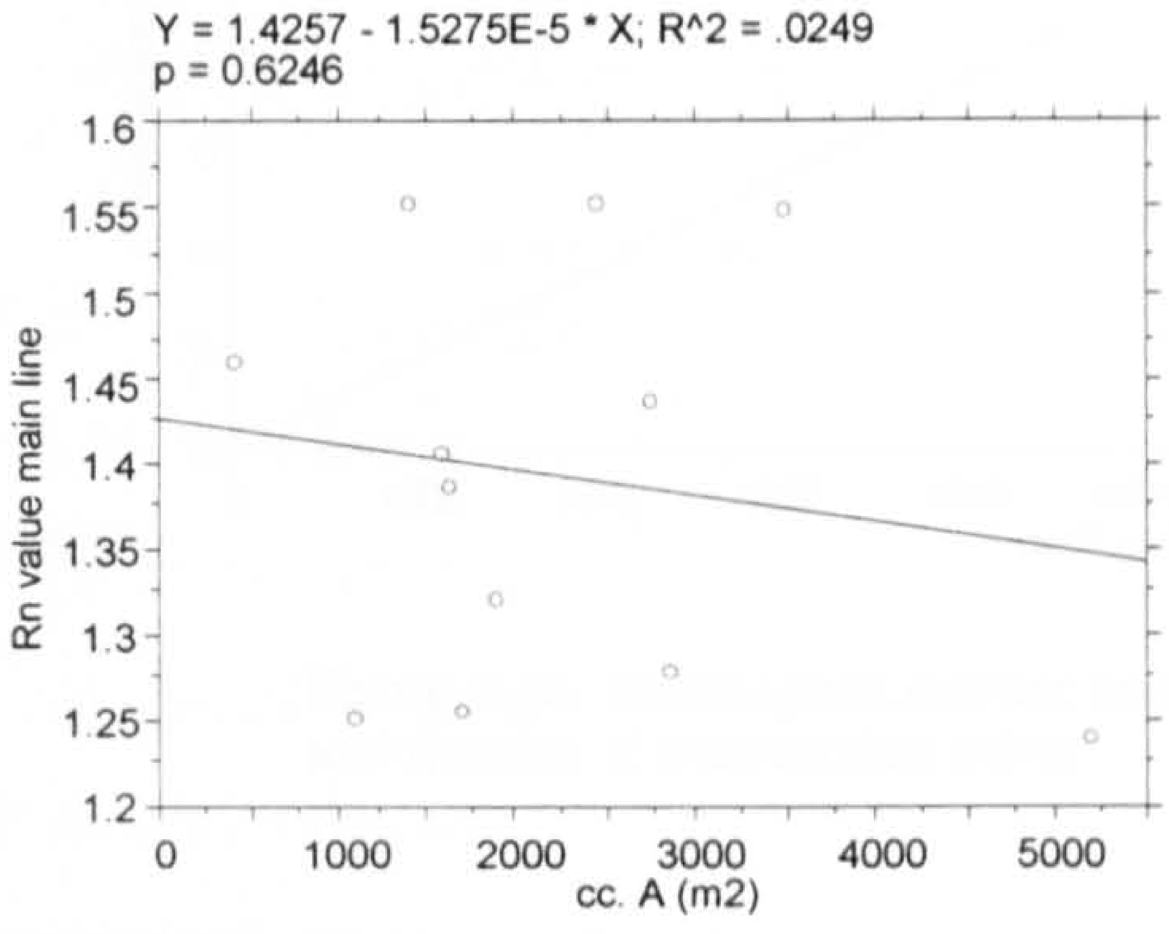

Figure 4.32. Scattergram convex container area and global integration value of main line

The characterisation of the embedding quality is then investigated. As seen from the study of traditional urban squares, the correlation matrix (Table 4.5, Appendix 2) suggests strong linear correlations between axial lines and convex isovists properties. To a certain extent it is an expected result, as here too, from any point inside an isovist, the observer has a direct view of the public space, as illustrated in Plate 4.15. Figure 4.33 shows the strong correlation between the area of the isovist and the sum of the length of the axial lines.

Lastly, examining the relationship between the area of public spaces and intersection points, Plate 4.17 gives a preliminary indication that the number of intersection points might be associated to the area of the convex container. The analysis of the data (Fig. 4.34) showed that there is indeed a positive linear correlation between the total number of intersection points and the size of public spaces[27].

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[27] Because of the distribution of points along the regression line, the data was analysed using the Kendall rank correlation test with positive results: Tau corrected for ties = 0.6145 with p = 0.0054.

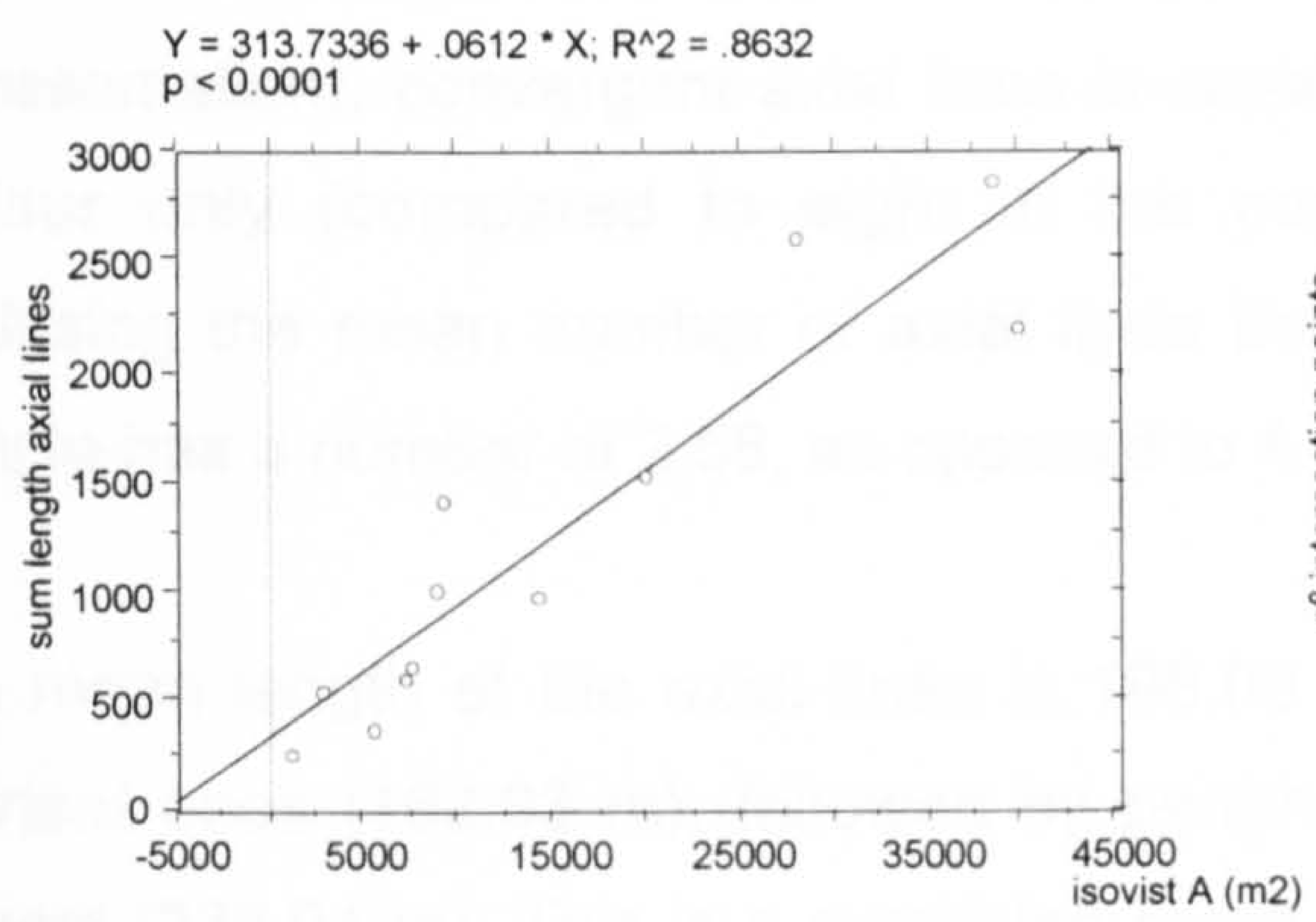

Figure 4.33. Scattergram isovist area and sum of length of axial lines – convex container

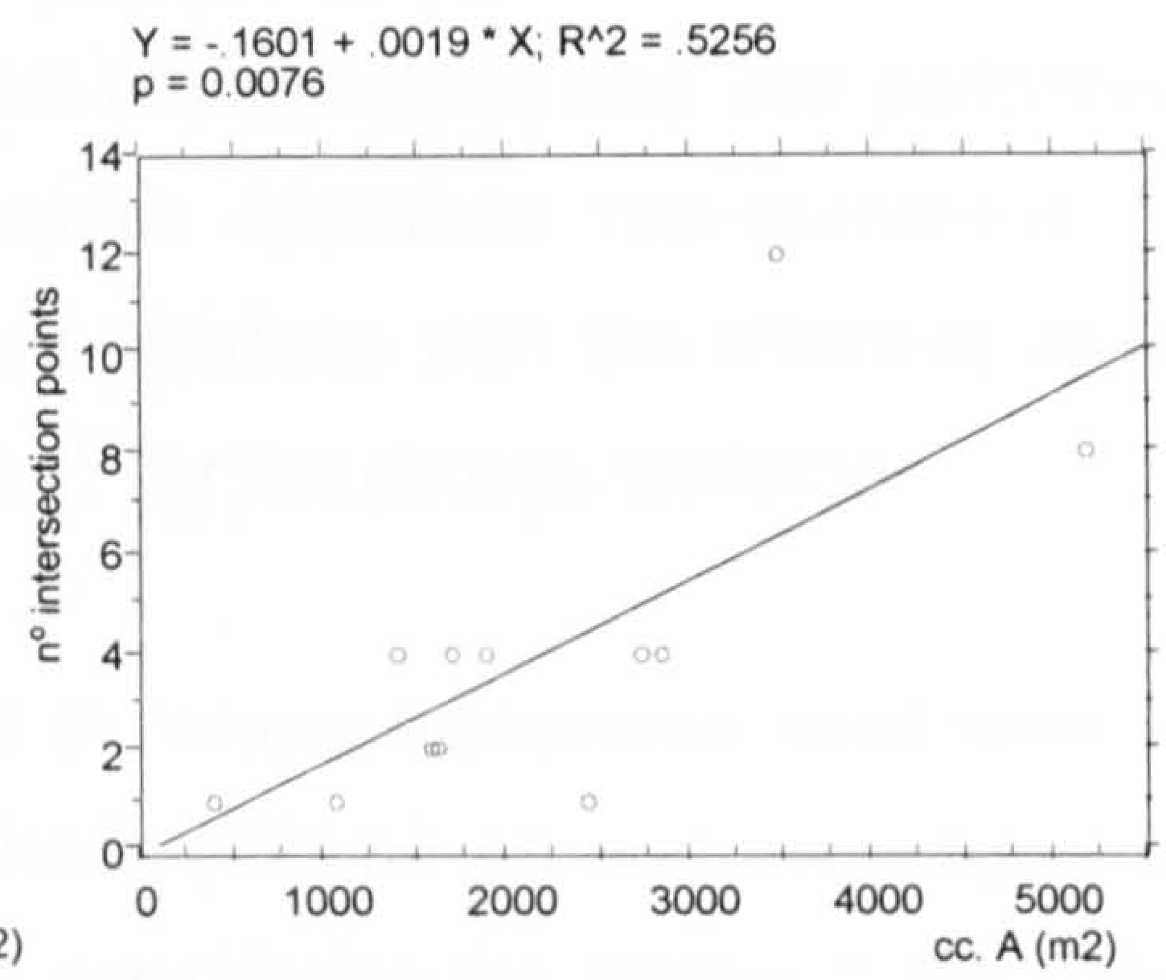

Figure 4.34. Scattergram convex container area and number of intersection points

Convex container representation; results summary:

- The larger the convex container, the larger the number of axial lines.
- The number and the global integration values of T and P axial lines that interface with the convex container is independent of its size although there were not enough cases for a conclusive analysis (a positive correlation was found for C axial lines).
- The sum of the length of the axial lines that interface with the convex container is only weakly associated with its size.
- The mean length of the axial lines that interface with the convex container is independent of its size.
- The larger the convex container, the larger the strategic value and the local strategic value.
- The global integration value of the main line that interfaces with the convex container is independent of its size.
- The visual and permeability properties of the convex container correlate with each other.
- The larger the convex space, the larger the number of intersection points.

4.5.2.2. Effective space representation

For the effective space representation, the analysis showed a total number of 31 axial lines (19 axial lines less than the convex container representation) where convergent axial lines represent the majority with 45% of all cases, followed by transverse with 39% and peripheric with 16%. However, when looking at the distribution of the different types of axial lines, there is a clear shift compared to the convex container. Transverse axial lines are present in ten cases (compared to six in the convex container representation), convergent axial lines in seven (compared to ten) and peripheric ones in four only (compared to eight in the convex container representation). When analysing the mean number of axial lines that interface with the effective space, the sample has a number of 2.58, as opposed to 4.17 for the convex container.

The mean length of the axial lines is 198.03 m, where transverse axial lines are the shortest ones (162.93 m), followed by peripheric (173.30 m) and convergent are the longest (236.94 m). This is a surprising result considering the nature of the concept of the classification of axial lines and the previous results for the convex container sample, where there was a significant difference between the length of peripheric axial lines compared to the transverse and convergent ones. The axial lines that converge and terminate within the effective space are in fact the longest ones in the system, longer than both transverse and peripheric which are prolonged further outside in the effective space.

For the effective space representation, only 18 intersection points were identified, 78% of which are two intersecting axial lines. The remaining 22% consist of the intersection of 3 axial lines only (Plate 4.18). There are 3 cases without any intersection points within the limits of the effective space. Abchurchyard and Whittington Gardens have no intersection points since there is only one axial line that interfaces with the effective space. In the case of Fleet Place, all intersections occur outside the spatial boundary. The mean number is 1.50 intersection points per effective space. Considering intersection points of 2 intersecting lines, there is a mean of 1.167 intersection points. If we examine points of 3 intersecting axial lines, they are found in three effective spaces only. When examining the location of the intersection points, the results showed that there is also a tendency for the intersection points to be located at the edge of public spaces, as with 78% of cases. The analysis also showed (as for the convex container representation) that axial lines have a tendency to intercept within the same group or at specific locations.

Despite the decrease in the number of axial lines interfacing with the effective space, the analysis confirmed the previous results for the convex container representation on virtually all levels. Firstly, regardless of the type of pedestrian movement that the axial lines might be associated with, the relationship between the size of the effective space and axial lines is an "accumulative" property, ie, all lines (or all types of pedestrian movement) are important. Indeed, an analysis of the scattergrams showed a positive correlation for the area of the effective space and the total number of axial lines (Fig. 4.35). When the different types of axial lines were investigated, no correlation was found for any of the three cases (Figs. 4.36 to 4.38).

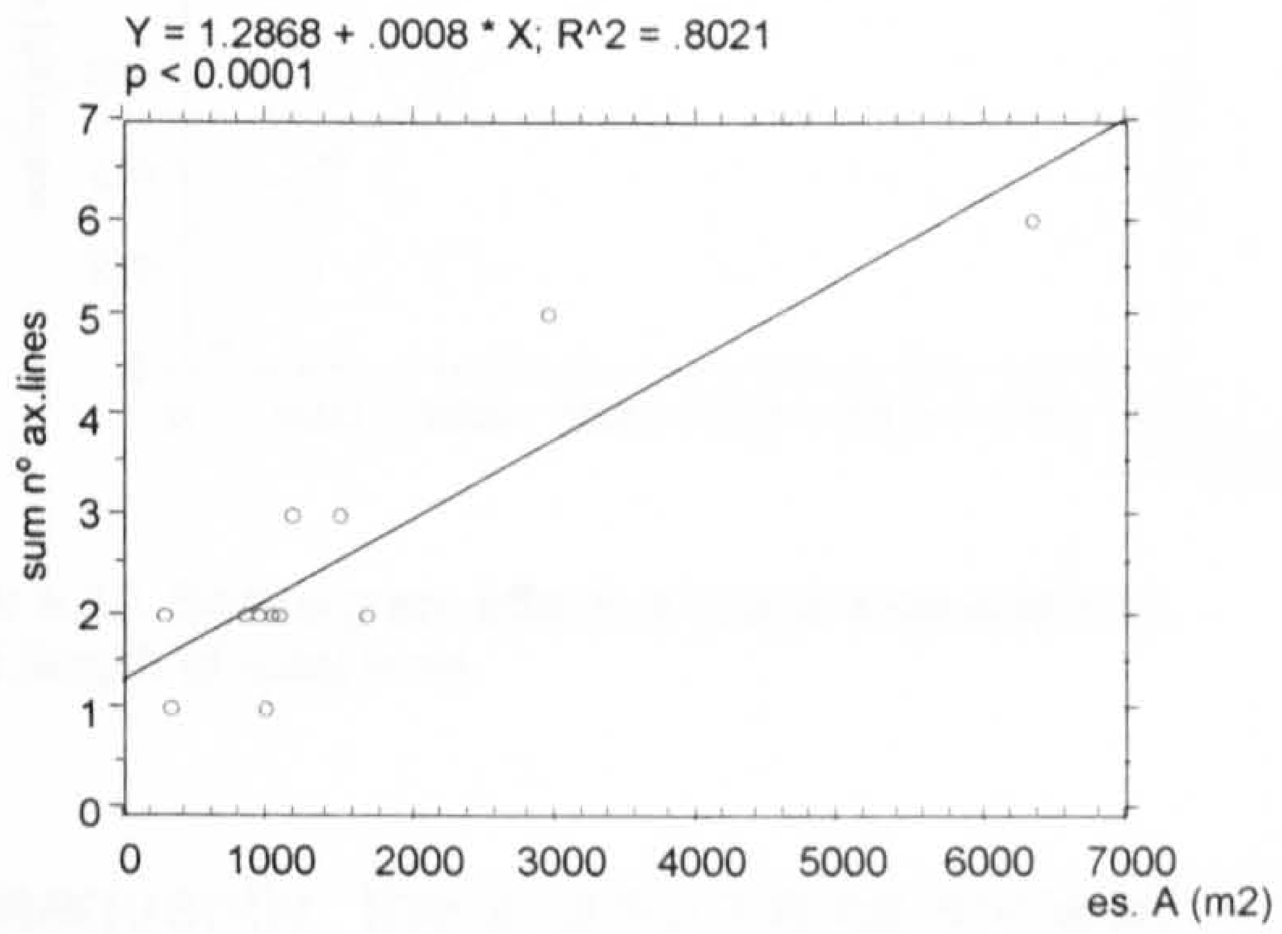

Figure 4.35. Scattergram effective space area and sum of nº of axial lines, n = 12

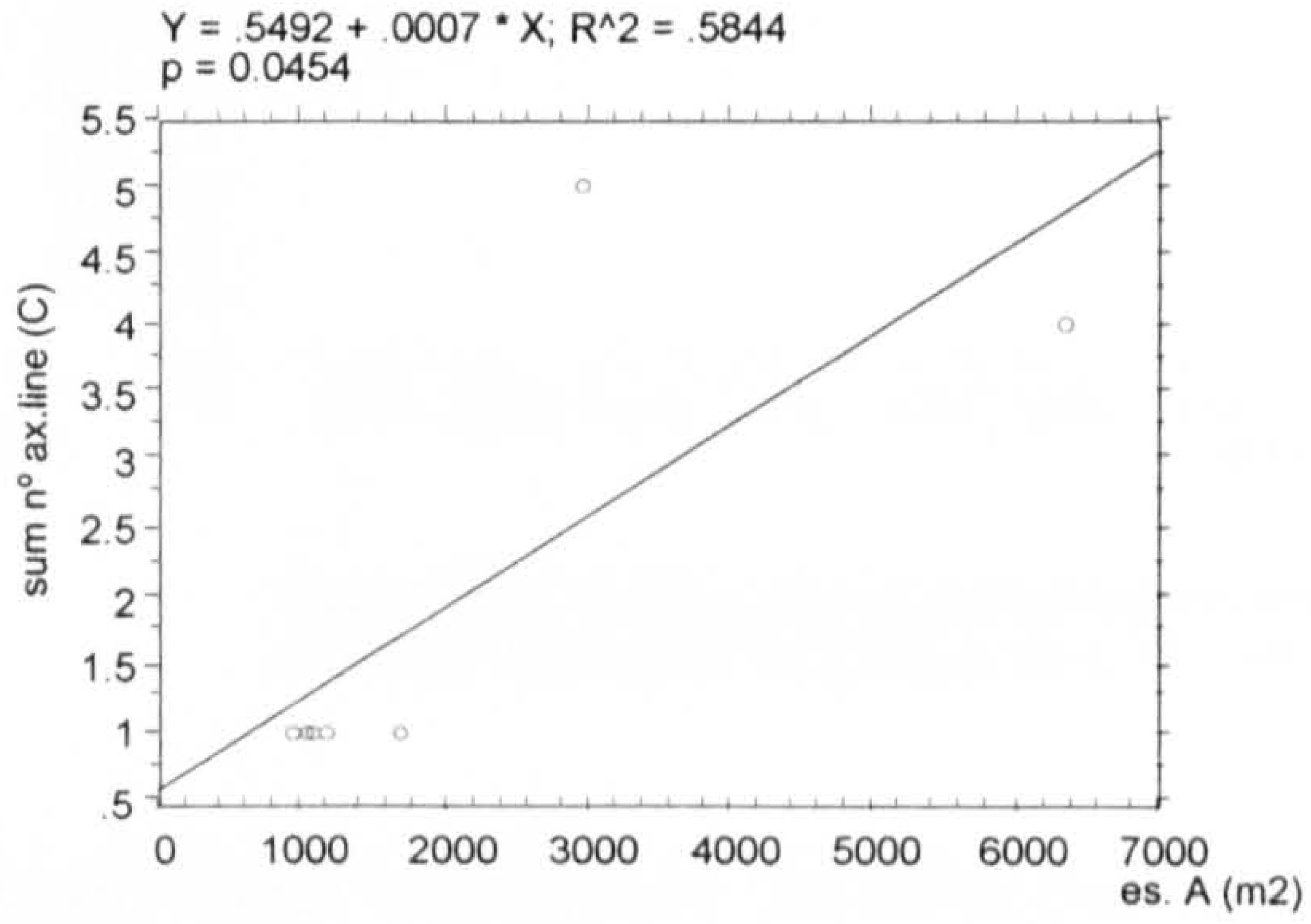

Figure 4.36. Scattergram effective space area and sum of nº of C axial lines, n = 7

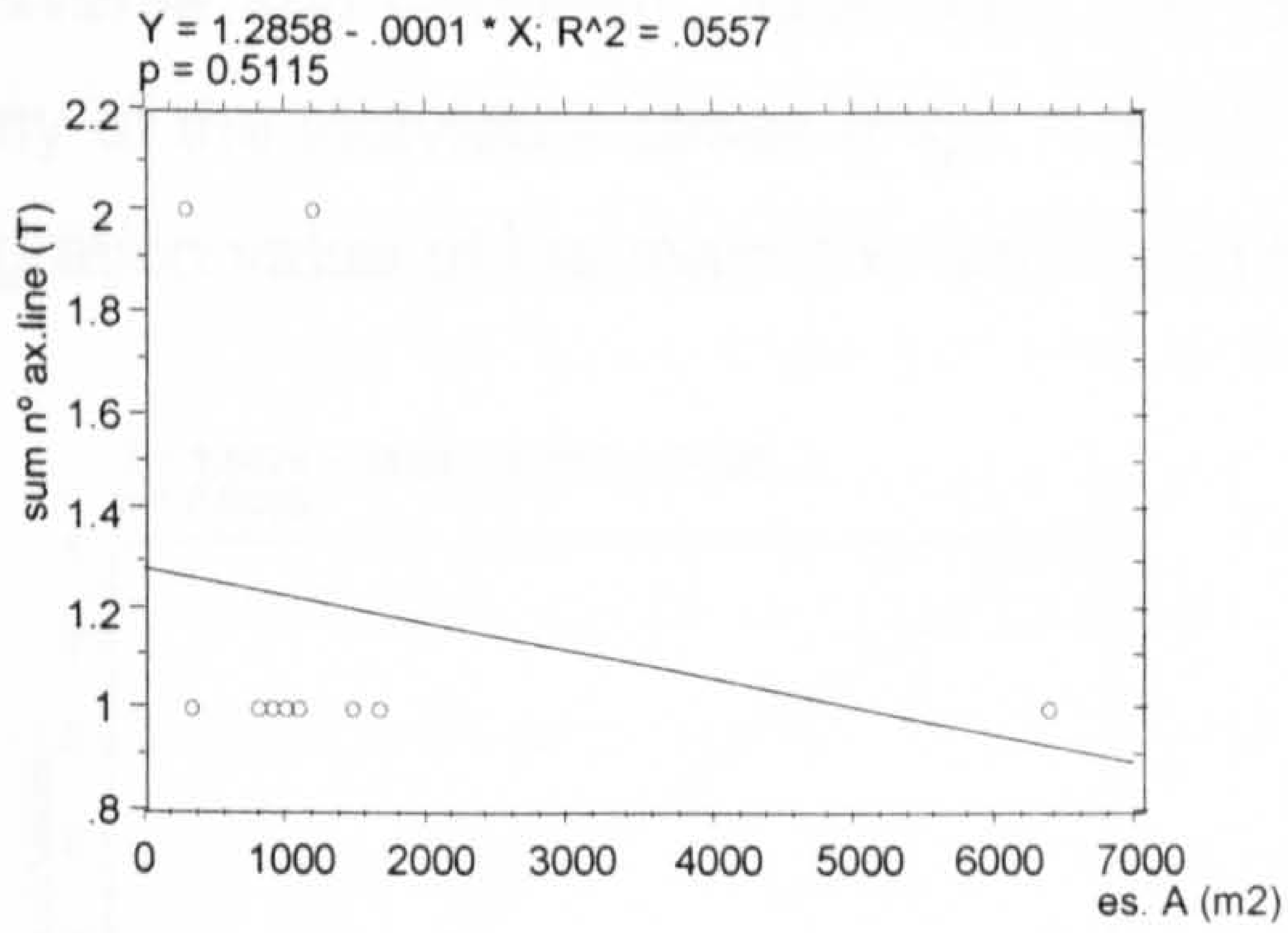

Figure 4.37. Scattergram effective space area and sum of nº of T axial lines, n = 10

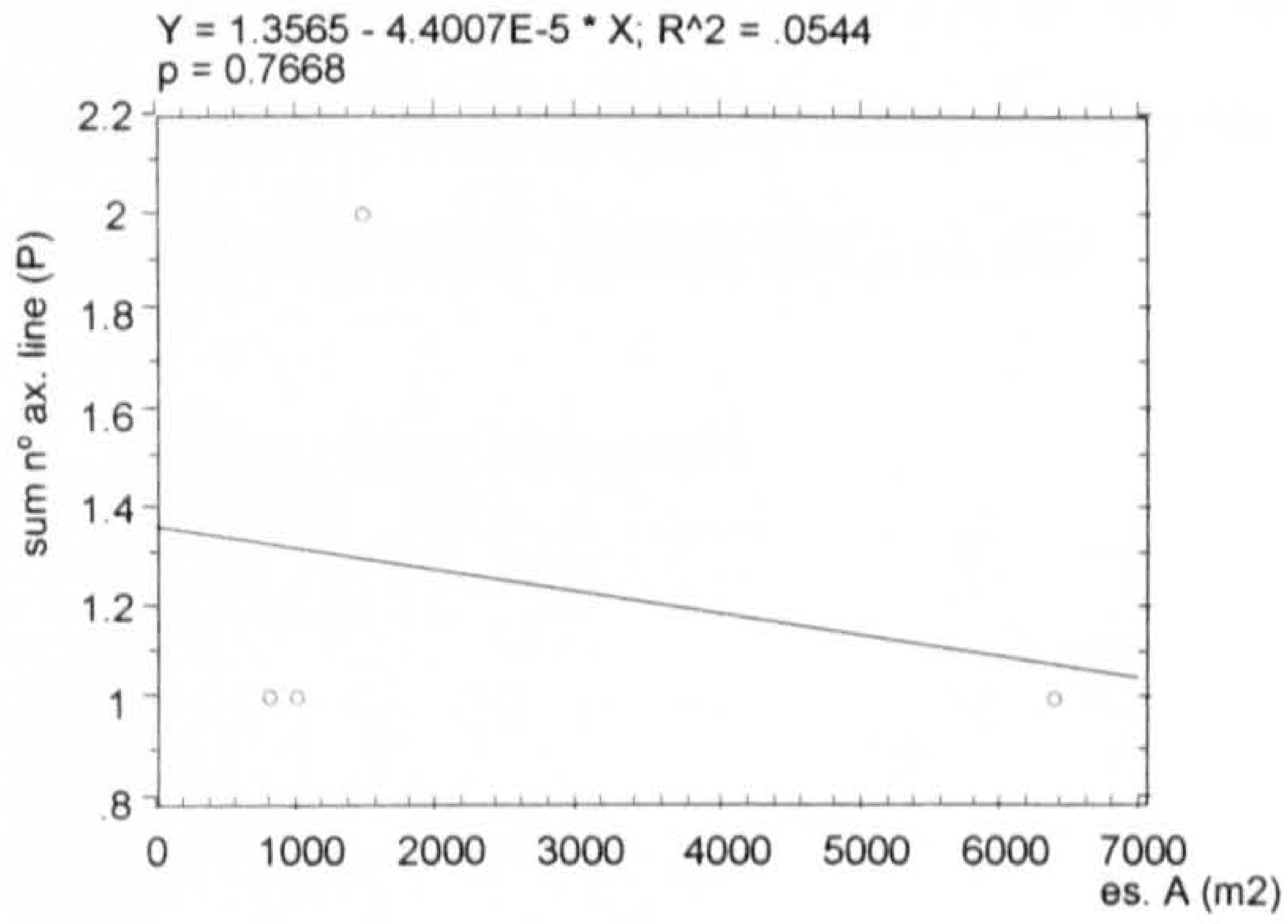

Figure 4.38. Scattergram effective space area and sum of nº of P axial lines, n = 4

For the metric properties of the axial lines, the scattergrams show, as for the convex container representation, a weak liner correlation for the sum of the length of the axial lines and the area of the effective space (Fig. 4.39) and no linear correlation for the mean length of the axial lines (Fig. 4.40), seen next.

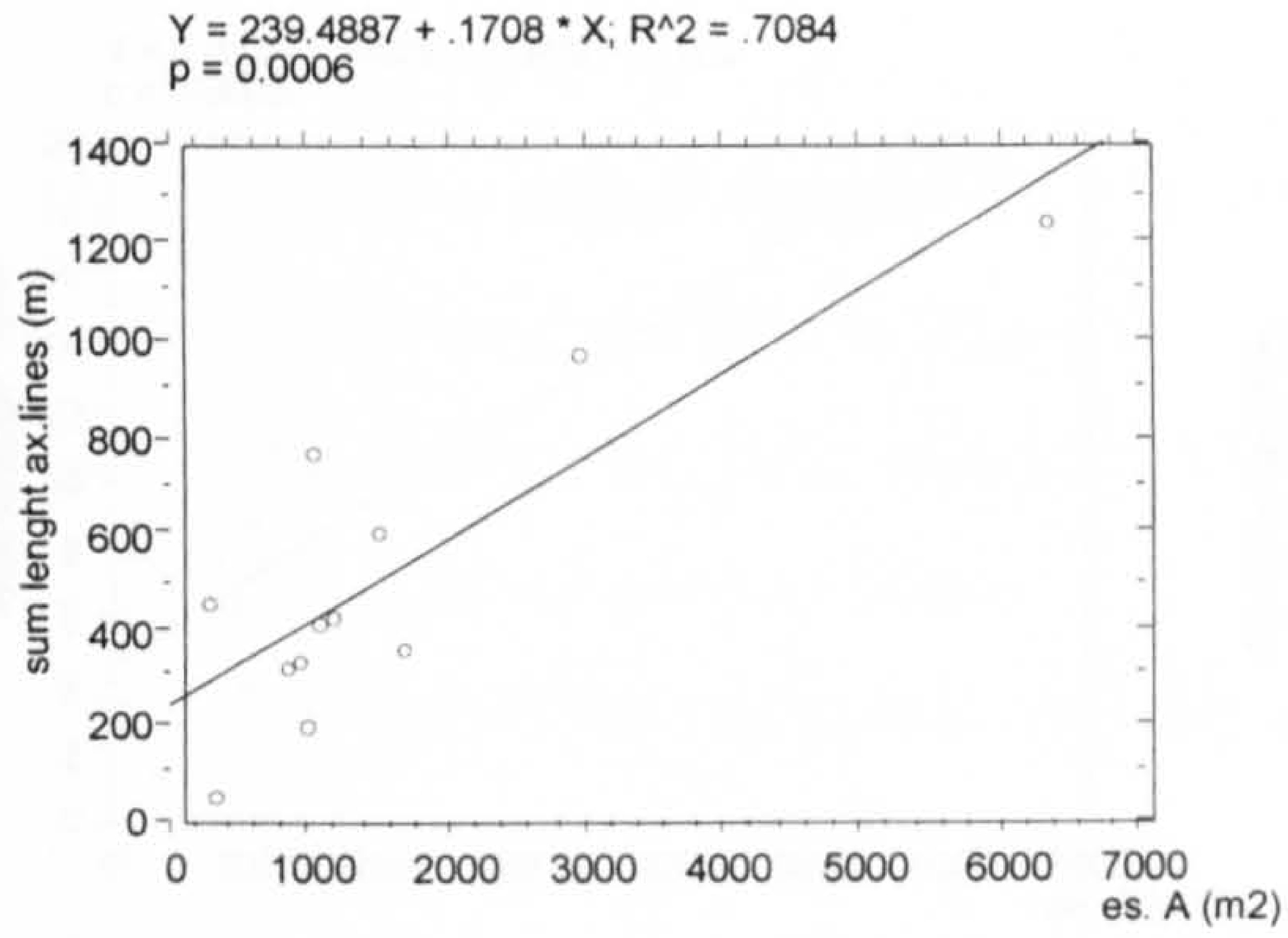

Figure 4.39. Scattergram effective space area and sum of the length of axial lines

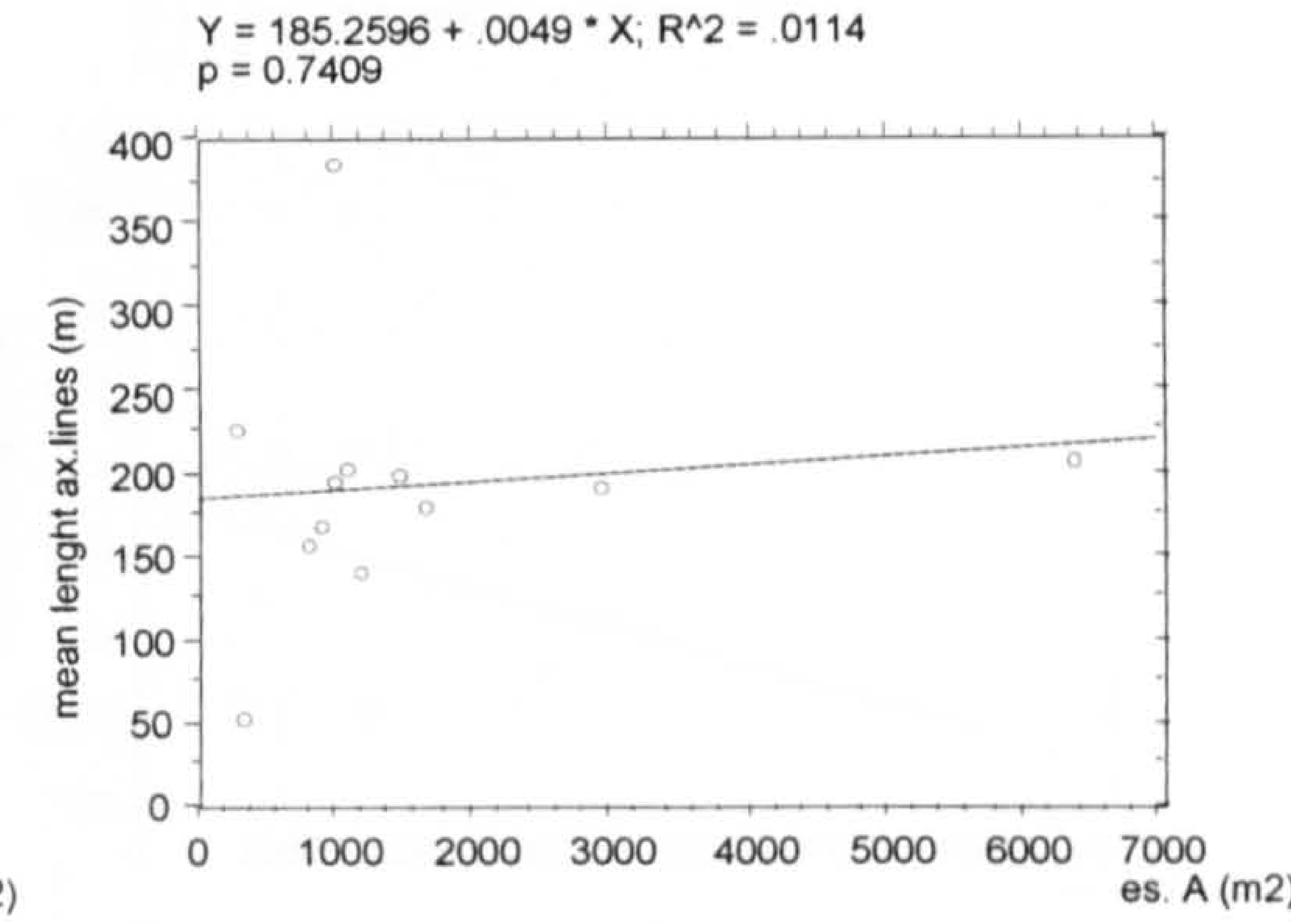

Figure 4.40. Scattergram effective space area and the mean of sum of length of axial lines

Subsequently, the scattergrams showed a good linear correlation between the strategic values and the local strategic value, and the area of the effective space (Fig. 4.41 and Fig. 4.45). As expected, when the analysis was made independently for convergent, transverse and peripheric axial lines, the results showed that this property is not found in any of the individual cases (Figs. 4.42 to 4.44). Also, no correlation was found for the integration value of the main line and the area of the effective space (Fig. 4.46).

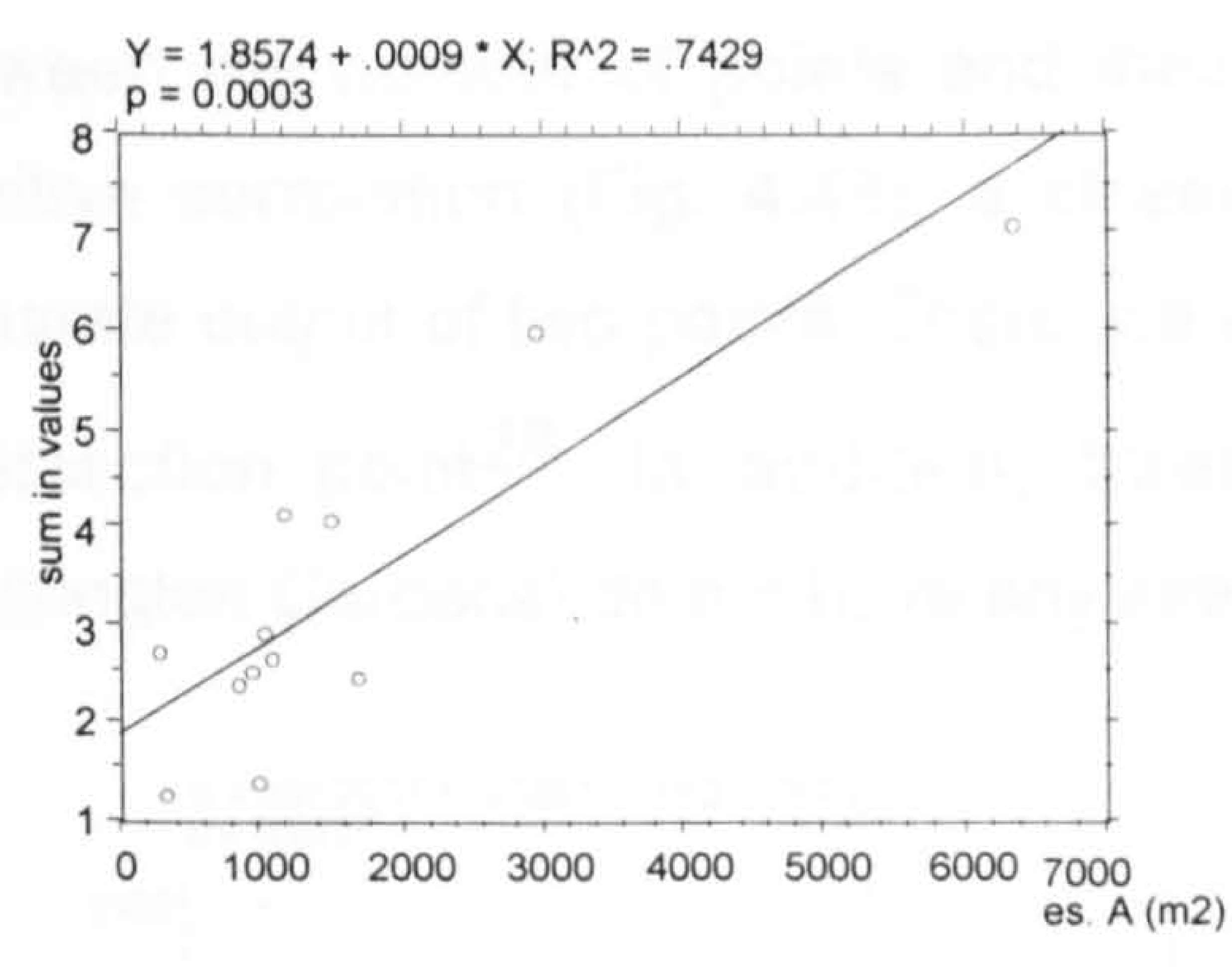

Figure 4.41. Scattergram effective space area and strategic value

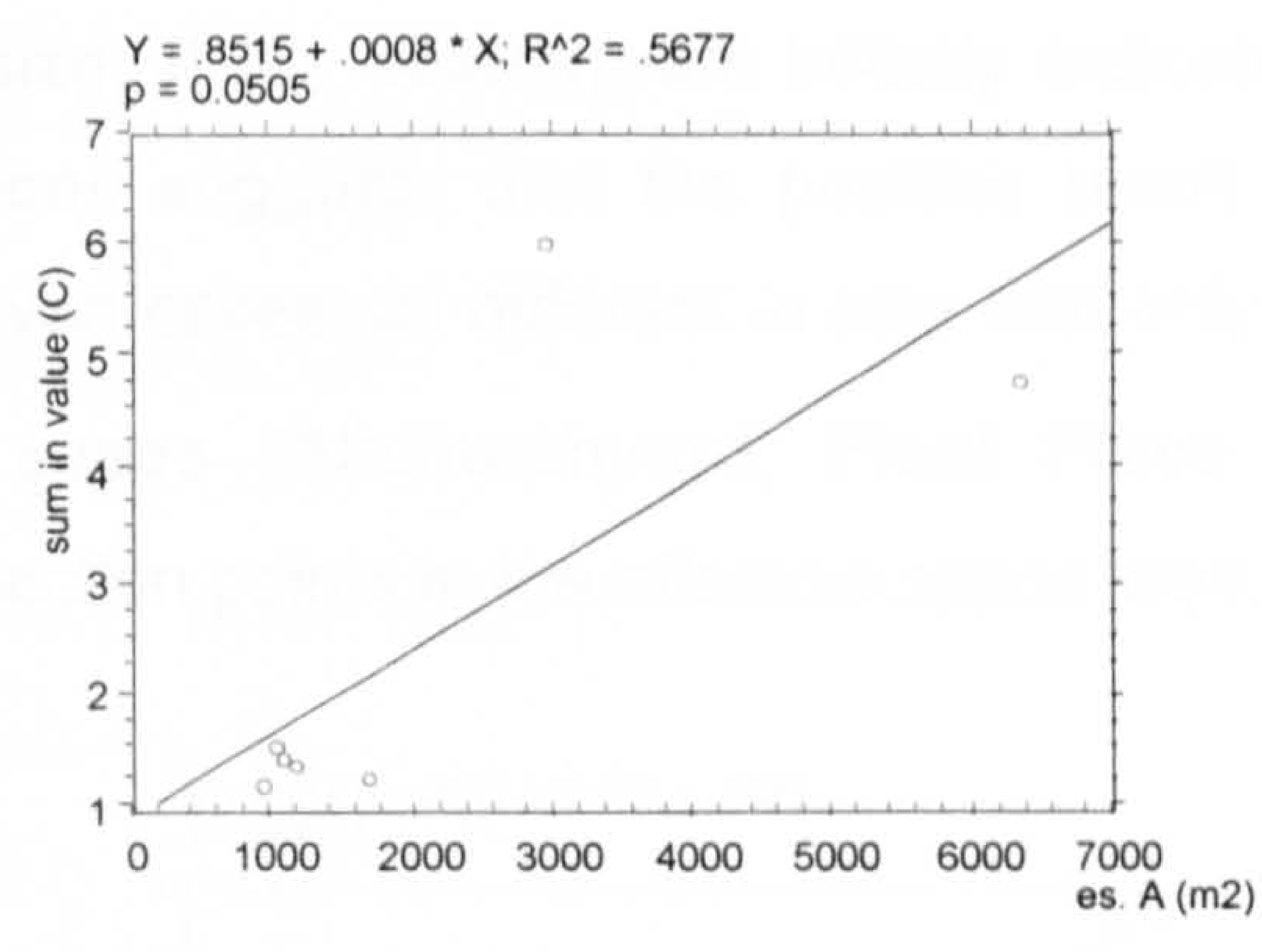

Figure 4.42. Scattergram effective space area and sum Rn values of C axial lines, n = 7

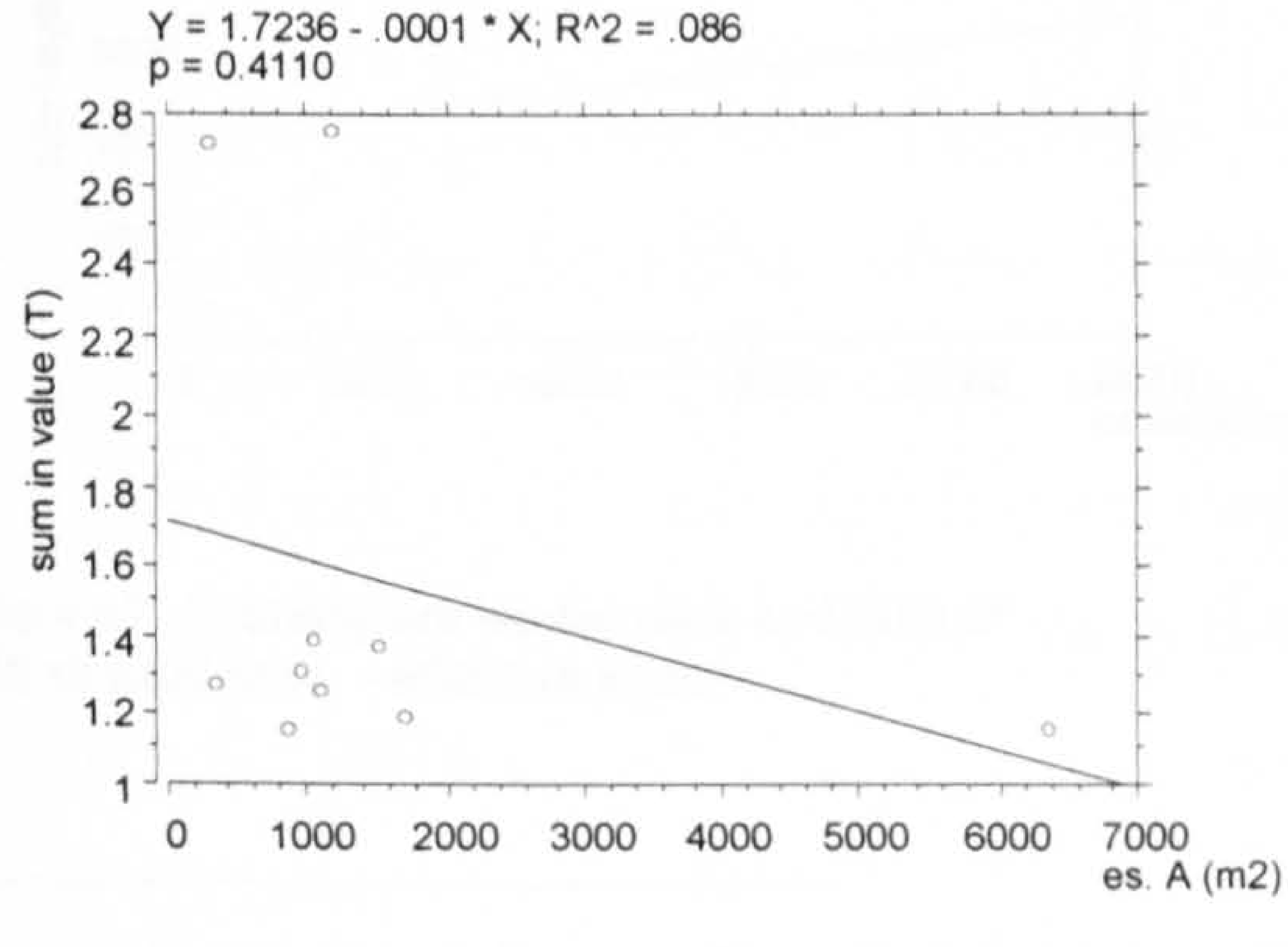

Figure 4.43. Scattergram effective space area and sum Rn values of T axial lines, n = 10

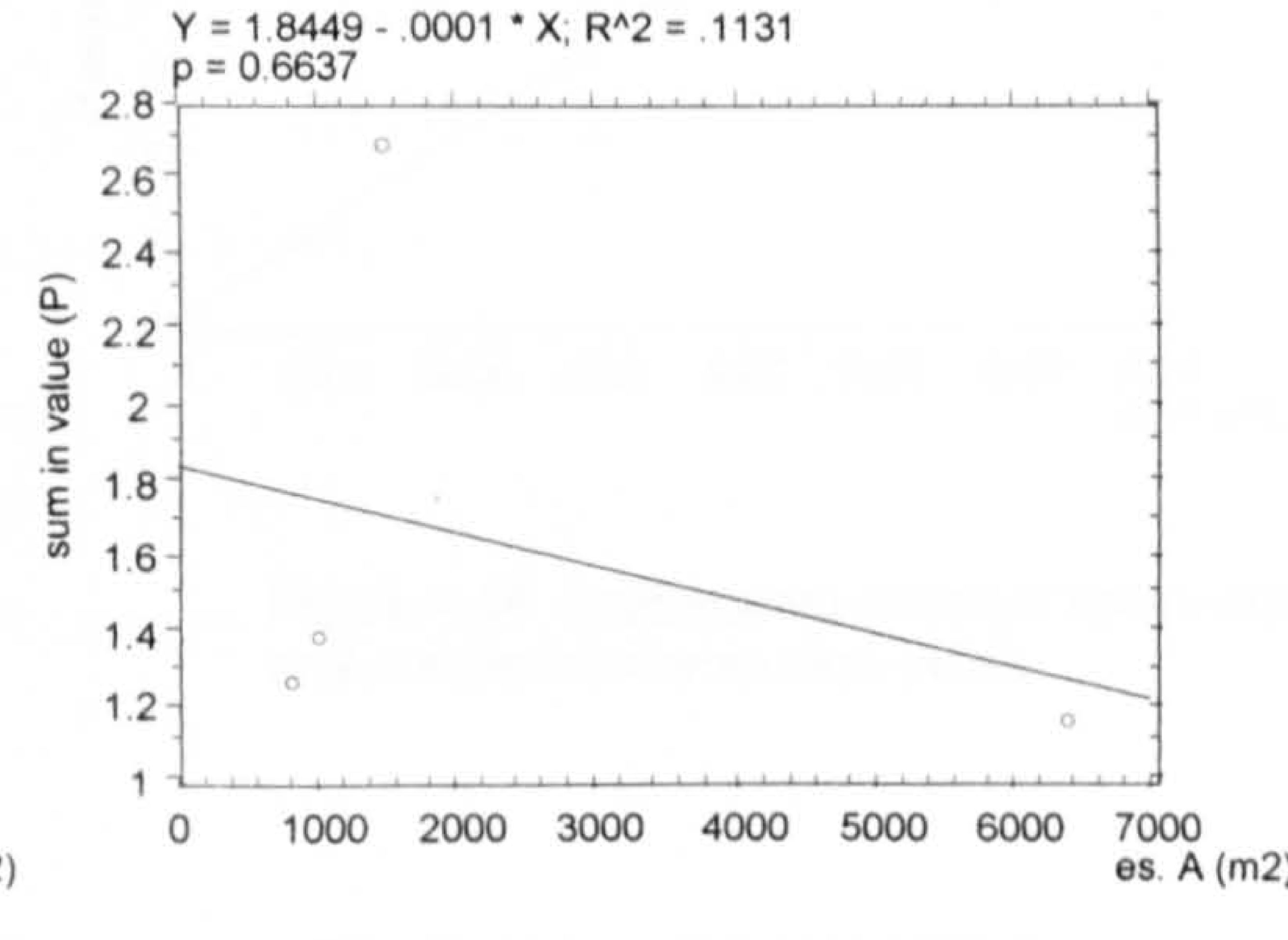

Figure 4.44. Scattergram effective space area and sum Rn values of P axial lines, n = 4

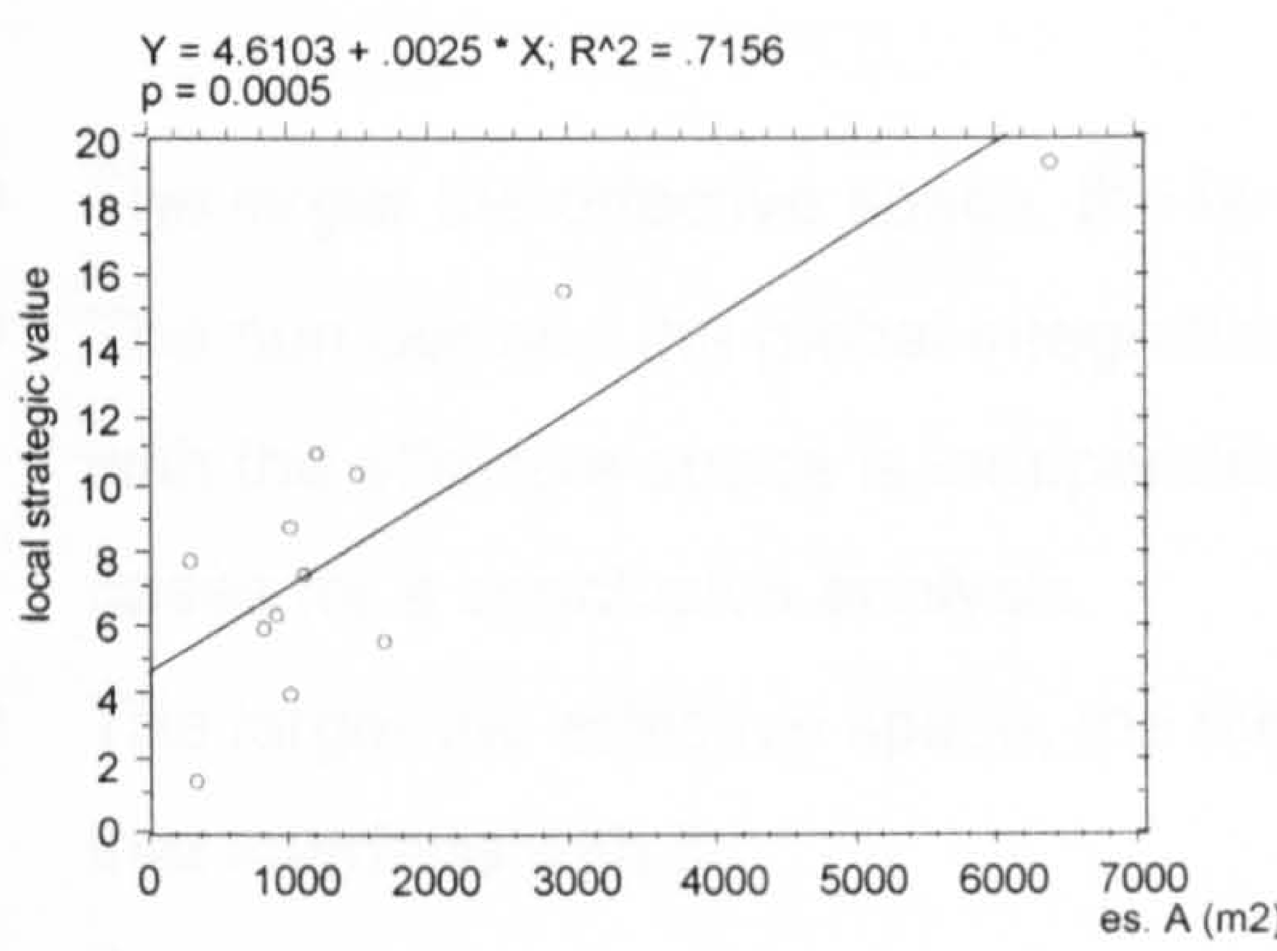

Figure 4.45. Scattergram effective space area and local strategic value

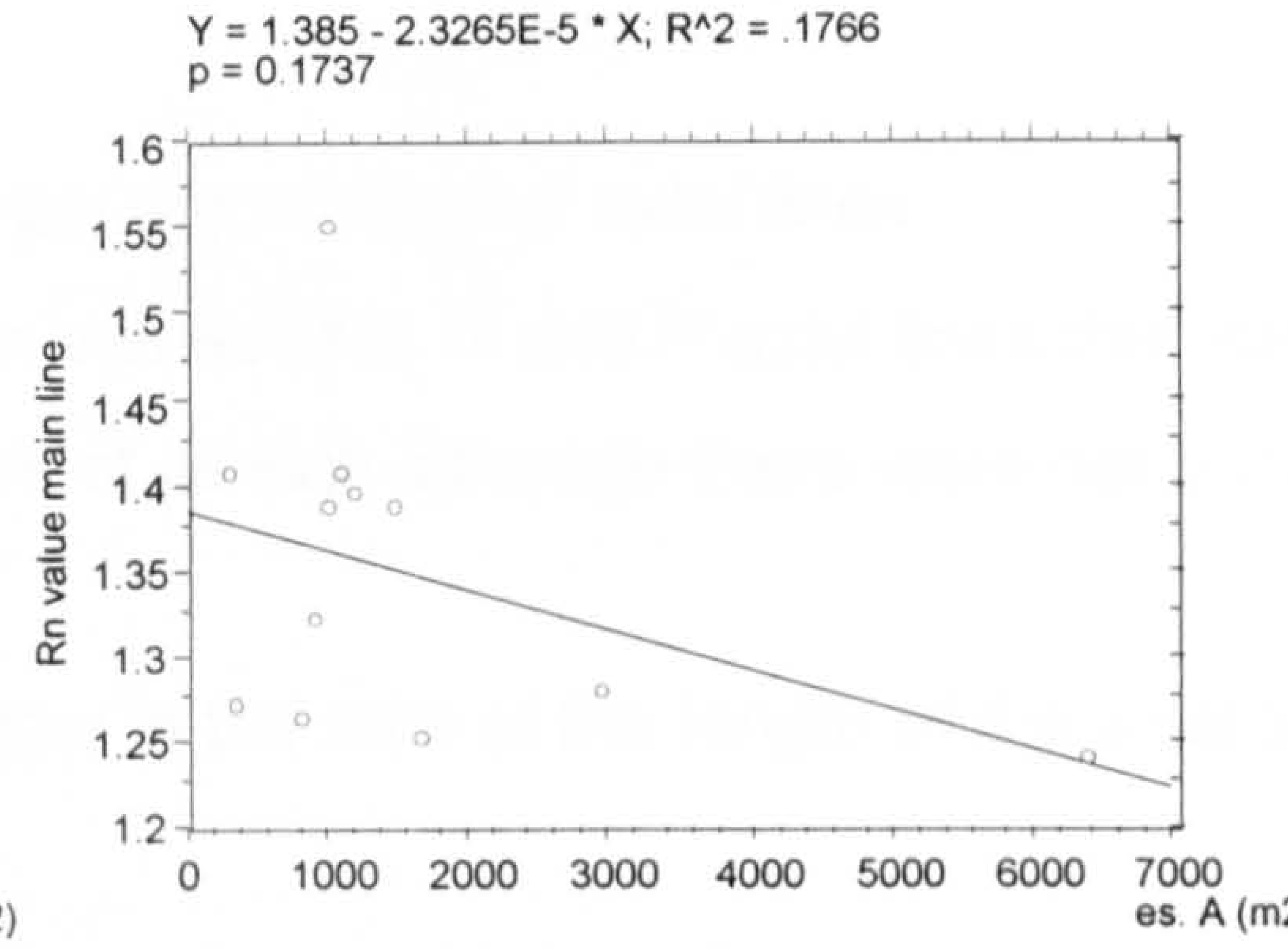

Figure 4.46. Scattergram effective space area and global integration value of main line

With the reduction of the area of the effective space and the appearance of the "peripheral isovists" (see Plate 4.16), the major effect on the characterisation of the embedding quality is the lack of correlation for the area of the isovist and the sum of the length of the axial lines. Figure 4.47 illustrates. So far, the reduction in the number of axial lines for the effective space representation has not affected the properties between the area of the effective space and axial lines. However, the relatively small number of intersection points per effective space accounts for the lack of correlation between the number of points and their size. If the scattergram initially indicates a positive correlation (Fig. 4.48), a closer look suggests that the positive result is a fortunate output of two points. There are seven cases, all different in size with only one intersection point[28]. In addition, three cases (Abchurchyard, Fleet Place and Whittington Gardens) do not have any intersection points in the effective space area.

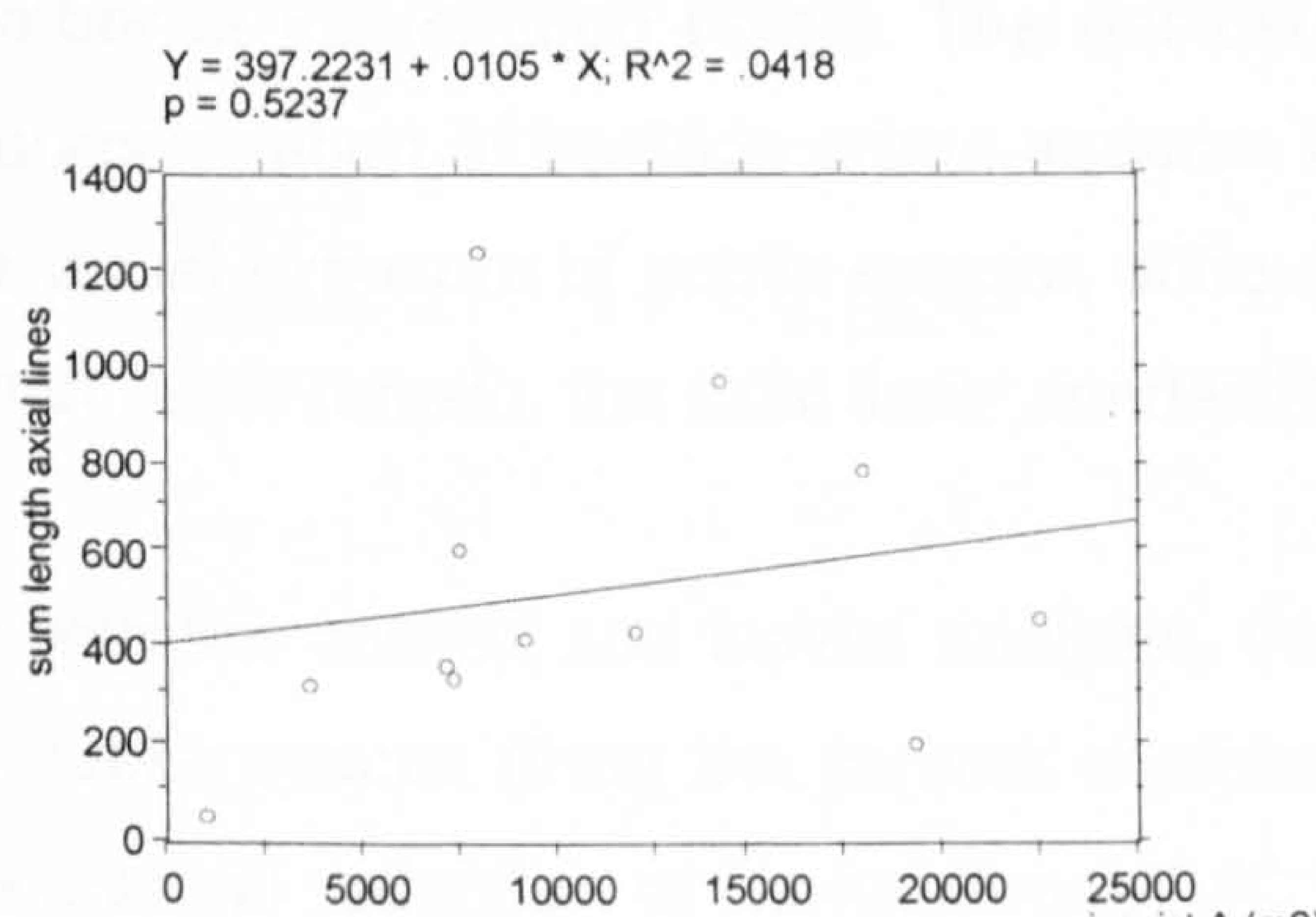

Figure 4.47. Scattergram isovist area and sum of length of axial lines - effective space

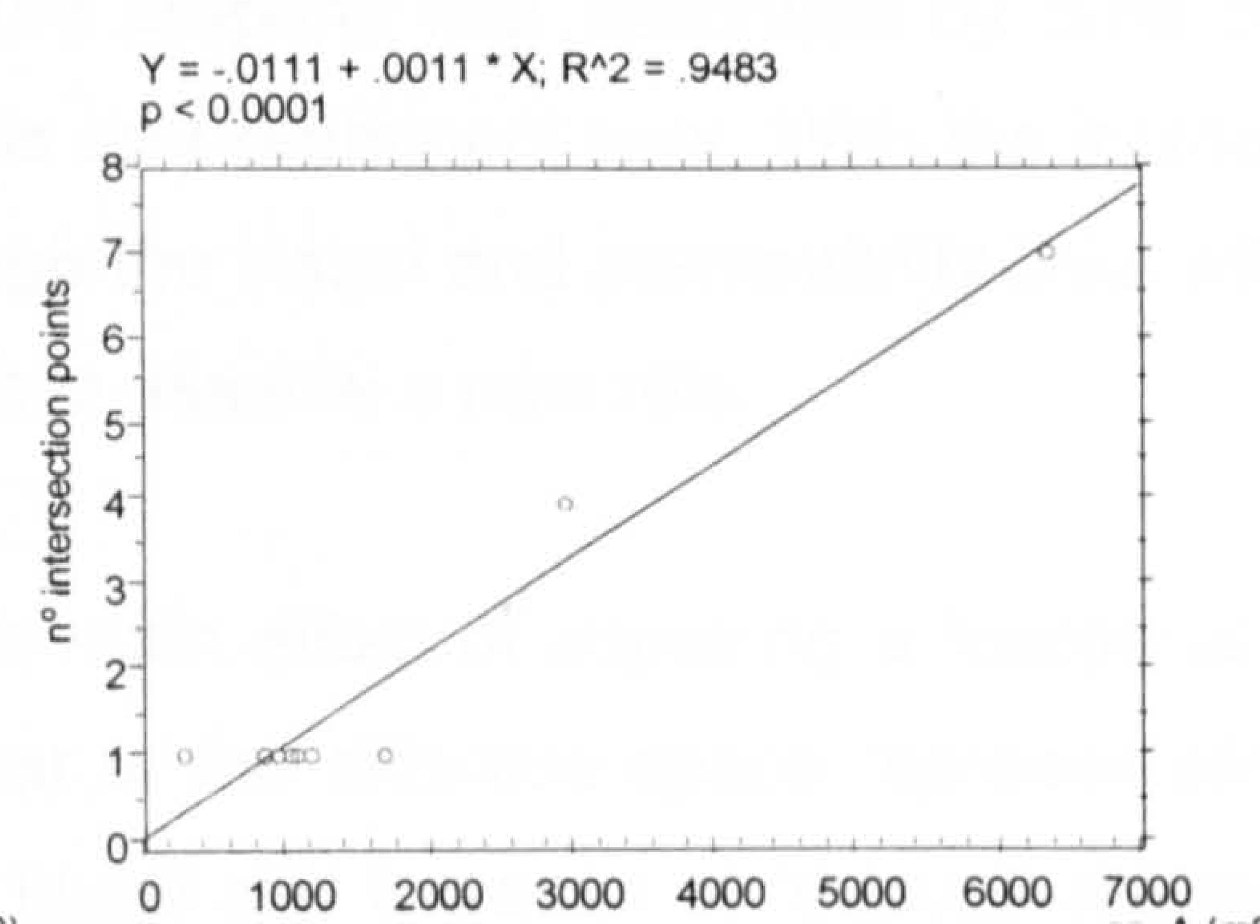

Figure 4.48. Scattergram effective space area and number of intersection points

[28] Kendal rank correlation confirms that there is not an association between the two variables as shown with Tau corrected for ties = 0.6455 and p = 0.1179.

Effective space representation; results summary:

- The larger the effective space, the larger the number of axial lines.
- The number and the global integration values of C, T and P axial lines that interface with the effective space is independent of its size although there were not enough cases for a conclusive analysis.
- The larger the effective space, the larger is the sum of the length of the axial lines that interface with it.
- The mean length of the axial lines that interfaces with the effective space is independent of its size.
- The larger the effective space, the larger the strategic value and the local strategic value.
- The global integration value of the main line that interfaces with the effective space is independent of its size.
- The visual and permeability properties of the effective space are independent of each other.
- The number of intersection points is independent of the size of the effective space.

4.5.2.3. Comparing convex container and effective space representations

On comparison of the data summarised in Table 4.12, next page, it is clear that the area of the effective space representation is smaller than that of the convex container, the number of axial lines intercepting with the public spaces is also smaller, as is the number of intersection points. The enclosure property first described by Sitte on the characterisation of tradition urban squares is less prominent now. With the increase in the visual exposure of public spaces, although the visual and permeability links with the urban fabric remain, the axial lines' connections assume a new role.

As with the convex and isovist analysis, the main effect of imposing a functional logic on public spaces (from the convex container to the effective space representation) is the gradual reduction of "to-movement" (C lines) and increase of "through-movement" (T lines). Despite the fact that C axial lines still form the majority of the sample, their distribution amongst the cases have decreased in contrast to T lines, where the number of P lines are few.

Representation	Space area (m2)	Mean n° axial lines/ space	Mean n° intersection pt./ space	Distribution C axial lines	Distribution T axial lines	Distribution P axial lines	Number of C axial lines	Number of T axial lines	Number of P axial lines
Convex Container	2188	4.17	3.9	10/12	6/12	8/12	29/50 (58%)	8/50 (16%)	13/50 (26%)
Effective Space	1593	2.58	1.5	7/12	10/12	4/12	14/31 (45%)	12/31 (39%)	5/31 (16%)

Table 4.12. Interfacing axial lines comparative measures

However, despite this decrease in number and change in the distribution profile of axial lines in the effective sample representation when compared to the convex container, the morphological properties in relation to the size of the public spaces keep the same pattern, with exception for the relationship between axial lines and isovists. For all the properties which were examined, the most important finding is the relationship between the size of the public space and the strategic value, as confirmed by the analysis of the stepwise regression (Plates 4.20 and 4.21)[29]. This suggests an important property. Conjecturing that there is a relationship between the number of static people and the strategic value (Hillier, 1984), the larger the public space, an increase in the strategic value is an important attribute regarding the level of static occupation of public spaces.

Stepwise regression summary

convex container area vs. 14 independent variables

F-to-Enter	4.0000
F-to-Remove	3.9960
Number of Steps	1
Variables Entered	1
Variables Forced	0
Stepwise Procedure	Forward

Variables In Model

convex container area vs. 14 independent variables

Step: 1

	Coefficient	Std. Err	Std. Coeff.	F-to-Remove
intercept	233.8787	742.3191	233.8787	.0993
strategic value	352.3747	123.7476	.6692	8.1084

Variables Not In Model

convex container area vs. 14 independent variables

Step: 1

	Partial C..	F-to-Enter
isovist area	-.1098	.1099
visibility ratio	-.5087	3.1422
enclosure ratio	-.3423	1.1943
sum isov length (total)	-.0413	.0154
mean isov length (total)	-.0976	.0865
sum isov length (selc)	-.3059	.9289
mean isov length (selc)	-.0508	.0232
sum isov length (spec)	-.1140	.1185
mean isov length (spec)	-.0850	.0655
sum length axial lines	-.2176	.4475
mean length ax.lines	-.0256	.0059
local strategic value	-.1364	.1705
Rn value main line	-.5176	3.2944

Plate 4.20. Convex container stepwise regression analysis summary

29 When excluding the total number of axial lines.

Stepwise regression summary

effective space area vs. 14 independent variables

F-to-Enter	4.0000
F-to-Remove	3.9960
Number of Steps	1
Variables Entered	1
Variables Forced	0
Stepwise Procedure	Forward

Variables In Model

effective space area vs. 14 independent variables

Step: 1

	Coefficient	Std. Error	Std. Coeff.	F-to-Remove
intercept	-1104.0253	562.5426	-1104.0253	3.8517
strategic value	814.9255	151.5941	.8619	28.8982

Variables Not In Model

effective space area vs. 14 independent variables

Step: 1

	Partial Cor.	F-to-Enter
isovist area	-.2729	.7241
visibility ratio	-.3330	1.1228
enclosure ratio	.1493	.2052
sum isov length (total)	-.2842	.7906
mean isov length (total)	-.3473	1.2347
sum isov length (selc)	-.4391	2.1493
mean isov length (selc)	-.3621	1.3581
sum isov length (spec)	-.4161	1.8847
mean isov length (spec)	-.3475	1.2361
sum length axial lines	.2328	.5157
mean length ax.lines	-.0990	.0890
local strategic value	-.0721	.0470
Rn value main line	-.4487	2.2687

Plate 4.21. Effective space stepwise regression analysis summary

4.5.3. THE EMBEDDING ANALYSIS

This section examines the relationship between the accessibility of the public spaces in the context of the City of London urban fabric. The two models of representation are studied by comparing the local (R3) and global integration values (Rn) of the axial lines that interface with the models in relation to the remaining lines of axial map[30]. In addition, the models' "integration value"[31] is compared to the values of the other axial lines of the system. Table 4.13 presents the data used for the embedding analysis for both representations.

Names	Rn value convex container	Mean Rn value "London"	Rn value cc. R	Rn value effective space	Mean Rn value "London"	Rn value es. R
Abchuchyard	1.3822	1.0328	1.3383	1.1302	1.0334	1.0937
Bank Corner	1.3967	1.0328	1.3523	1.3441	1.0334	1.3006
Exchange Sq.	1.3974	1.0328	1.3531	1.1166	1.0334	1.0805
Fenchurch Place	1.1681	1.0328	1.1310	1.1225	1.0334	1.0862
Finsbury Av.	1.1377	1.0328	1.1015	1.1381	1.0334	1.1013
Fleet Place	1.2575	1.0328	1.2176	1.2583	1.0334	1.2176
Love Lane Corner	1.1689	1.0328	1.1318	1.1691	1.0334	1.1313
New Change	1.4050	1.0328	1.3604	1.2344	1.0334	1.1945
North Guildhall	1.1168	1.0328	1.0813	1.1173	1.0334	1.0812
Royal Exch.	1.3974	1.0328	1.3531	1.2266	1.0334	1.1870
St Anne St Agnes	1.2691	1.0328	1.2287	1.2342	1.0334	1.1943
Whittington Gds.	1.2753	1.0328	1.2348	1.2179	1.0334	1.1786

Table 4.13. Convex container and effective space representations embedding analysis data

30 See Section 4.4.

31 The global integration value of convex container and effective space models was calculated by drawing an axial line that intercepts with the axial lines that interface with the model and having the global integration values re-calculated. This methodology was first applied in the analysis of traditional squares in European towns as described in Sections 3.3.3.3 and 3.4.3.1, Chapter 3.

4.5.3.1. Convex container representation

The investigation commenced by examining whether the axial lines that interface with public spaces are part of the "integration core" composed of the 10% most integrated axial lines[32], that is, theoretically the 10% most accessible spaces. The analysis showed that 60% of all lines that interface with public spaces are part of the 10% integration core, and when not part of the integration core, they are all in the "secondary integration" core area[33]. Also, seven out of twelve public spaces (58%) had all their lines in the integration core[34]. The three public spaces with no axial lines in the integration core are all recent developments: Exchange Square, North Guildhall and Fenchurch Place. Apart from North Guildhall, both Fenchurch Place and Exchange Square have a high number of convergent axial lines (nine public spaces had at least one line part of the integration core).

Re-analysing the axial lines data in terms of C, T and P classification, the frequency distribution showed that only 41% of convergent axial lines are in the 10% integration core, compared to 75% for transverse and 92% for peripheric. Examining the axial lines that are not in the integration core, 85% are convergent axial lines. These results are very revealing. Despite the fact that convergent axial lines represent the vast majority of lines interfacing with the public spaces, it is the transverse and peripheric ones that belong to the integration core. Therefore, public spaces that have a high incidence of these lines are likely to have higher integration values. This can be illustrated by the case of Bank Corner with three peripheric lines or Royal Exchange with two convergent but four peripheric or transverse axial lines.

Another way of investigating how public spaces are utilised in everybody's daily routes is by comparing their integration values, ie, the integration value of the convex container representation, with the integration value of the axial lines of the study area. If we look at the global integration for the twelve selected cases, six had their integration values within the 10% core, in decreasing order: New Change/Cheapside Corner, Royal Exchange, Bank Corner, Abchurch, Whittington Gardens and St. Anne &

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[32] See Section 3.4.3 of Chapter 3.

[33] Ibid. 32.

[34] They are: Abchurchyard, Bank Corner, Fleet Place, New Change/Cheapside Corner, Royal Exchange, St. Anne & St. Agnes churchyard and Whittington Gardens.

St. Agnes churchyard. All, except for New Change/Cheapside Corner, were all pre-XX Century constructions. The first two, Bank Corner and Royal Exchange were part of the development of the Royal Exchange building, a meeting point for traders and insurance dealers in the City since the XVI Century[35].

The remaining examples are former church burial grounds. This important result is supported by earlier observations by Hillier et al. (1983) and Zucker (1959), who suggested that commercial areas or market squares tend to be more accessible compared to church ones which are generally located in areas away from intense pedestrian movement. The further six cases fall outside the integration core, all have their values above the mean integration of the system. Three were developed in the late 1980's: Exchange Square, Finsbury Av. and Fleet Place. North Guildhall was developed in 1966 and Fenchurch Place in 1935. They are all on sites associated with train stations such as Exchange Square or Fenchurch Place or civic institutions as in the case of North Guildhall. The only exception is Love Lane Corner which was constructed on the former site of St. Mary Aldermanbury church which dates back to the XVII Century.

From these results, which illustrate how likely the public spaces are to be accessible in relation to other parts of the urban environment, it was expected that integration values of public spaces would be in proportion to their size. However, an analysis of the data showed that the integration value of the convex container is not associated to its size (Fig. 4.49).

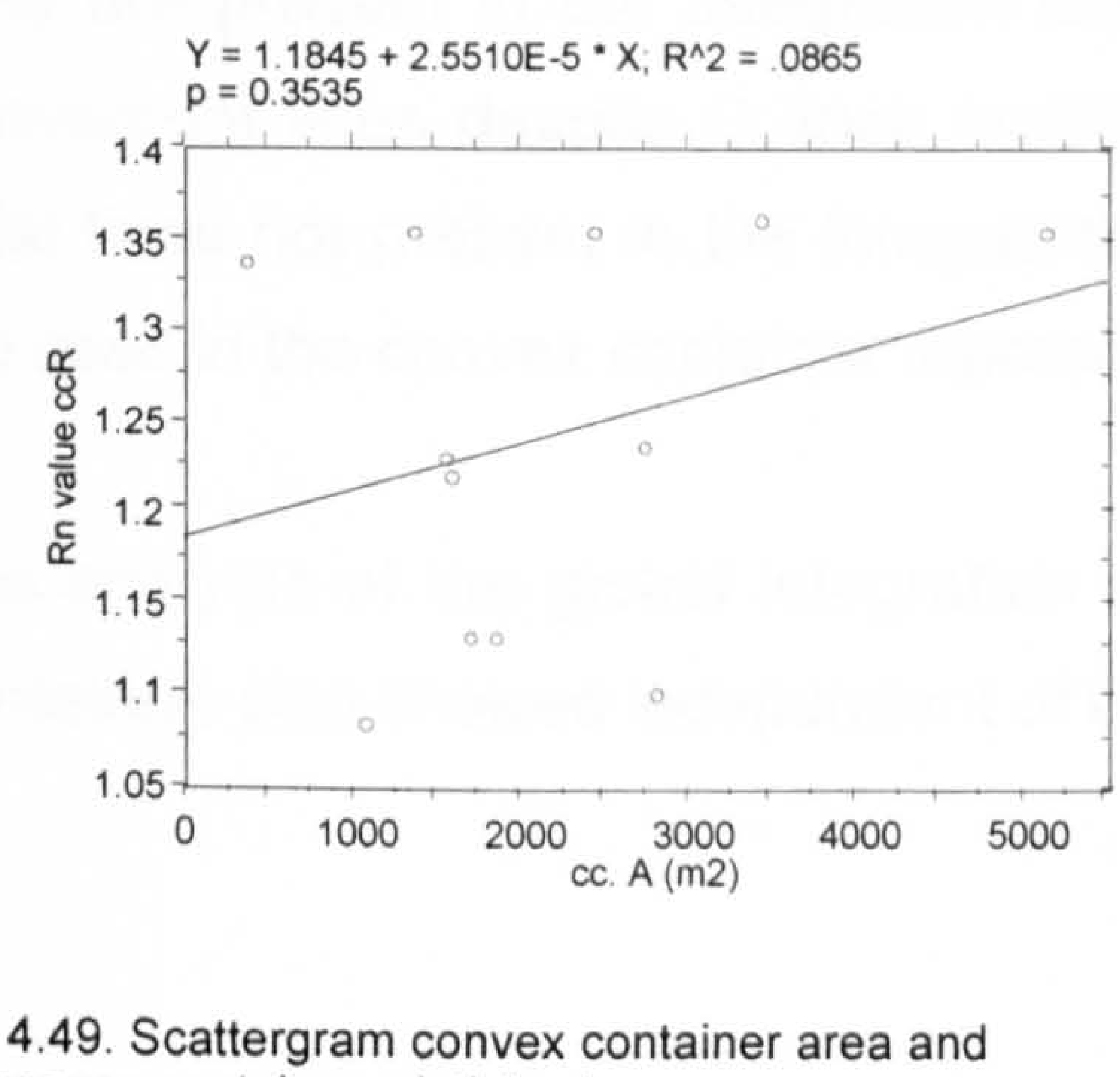


Fig. 4.49. Scattergram convex container area and Rn convex container relativised

35 Refer to Borer, 1962; Bradley and Pevsner, 1997; and Tames, 1995.

Convex container representation; results summary:

- All lines that interface with the convex container are above the mean integration values of the urban system and 60% are part of the 10% integration core.
- For 7 out of 12 cases, all axial lines that interface with the convex container are within the 10% integration core.
- For 6 out of 12 cases, the integration value of the convex container is within the 10% integration core.
- For all cases, the integration value of the convex container is above the mean integration value of respective towns.
- The global integration value of the convex container is independent of its size.

4.5.3.2. Effective space representation

When considering the axial lines that interface with public spaces, nine public spaces (75%) had at least one axial line as part of the 10% global integration core, with the remaining cases within the secondary local and global integration core area. The measurements also showed that six (Abchurchyard, Bank Corner, New Change, Royal Exchange, Fleet Place and Whittington Gardens) out of twelve spaces had all their axial lines in the urban core. The three public spaces with no axial lines in the integration core are again recent developments (Exchange Square, North Guildhall and Fenchurch Place) as found for the convex container sample. From the total number of axial lines, 48% belong to the 10% integration core, where for transverse axial lines, 67% are present in the integration core, 60% for peripheric lines and only 29% for convergent lines despite C lines making up the majority of the sample. From the 16 axial lines not present in the integration core, 63% are convergent axial lines, as was the case in the convex container representation.

The analysis of the global integration value of the effective space, as for the convex container, also showed independent of the effective space's size (Fig. 4.50).

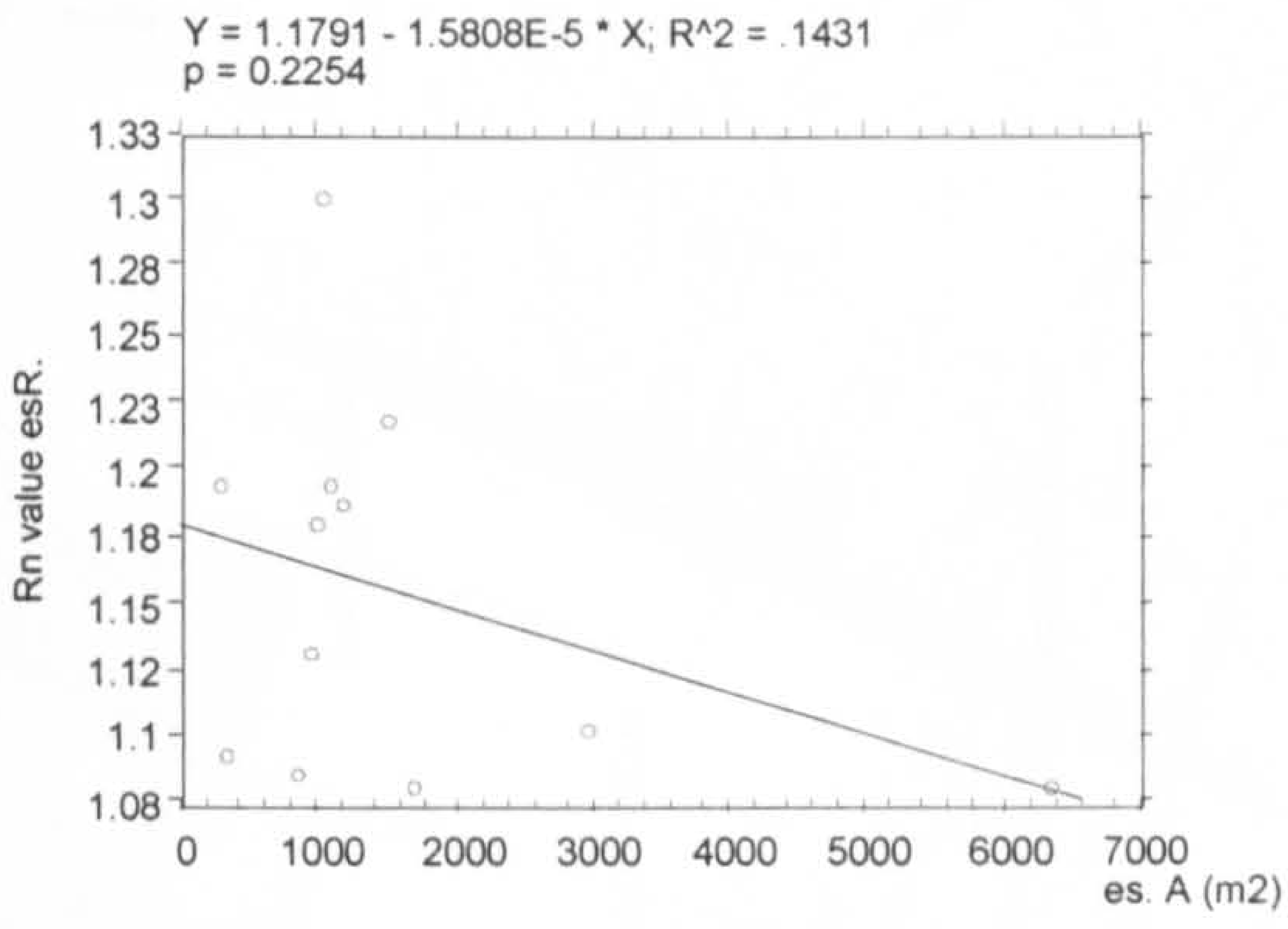


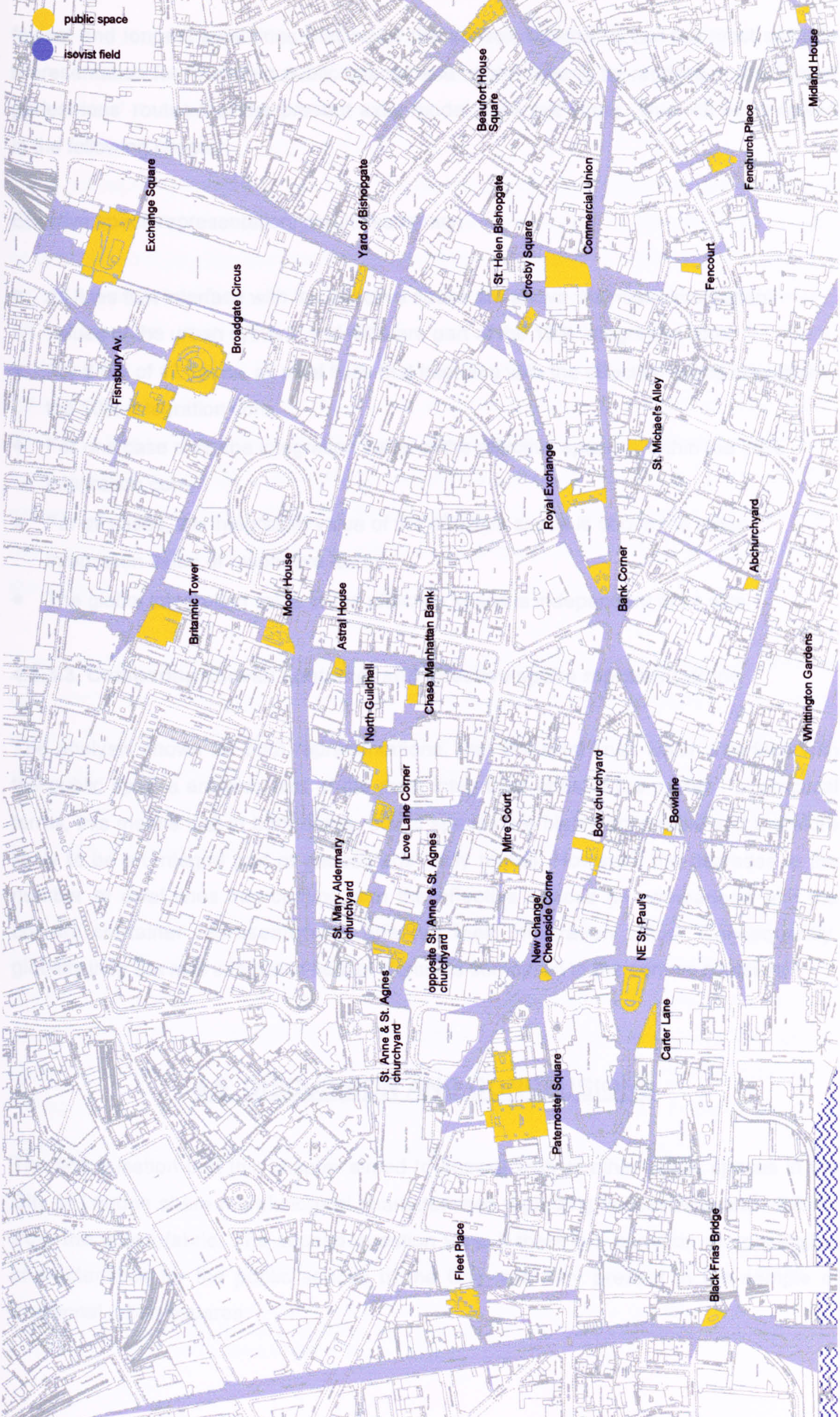
Fig. 4.50. Scattergram effective space area and
Rn effective space relativised

In addition, a comparison of the global integration value of the effective space to the values of axial lines in the system showed that there is only one public space, Bank Corner, in the 10% integration core, with all remaining effective spaces above the mean integration values of the system. Even if we enlarge the range to say 20%, still only six cases will be amongst the 20% most accessible places. These are, in decreasing order: Bank Corner, Fleet Place, New Change/Cheapside Corner, St. Anne & St Agnes churchyard, Royal Exchange and Whittington Gardens. In this case, the sample is a mix of commercial, former burial grounds and recent office developments. If we carry out the same analysis for local values, there is not a single effective space within the 20% local integration core.

Why should there be such a difference compared to the convex container sample? Even looking at local integration values, to see how locally accessible they are compared to the other elements, there is not any public space within the 10% local integration core and in fact only three cases will be above the mean R3 integration values.

If we look at Figure 4.51 which shows the isovists for the initial 35 cases when composing the sample for the comparative study on patterns of spatial use, we can see that the "Roman property" (Hillier, 1996) is found in public spaces in the City of London. Taken as a set, public spaces comprise a network of open spaces that are interconnected by their respective isovists with the exception of just a few isolated cases. But then, the plan only illustrates 35 cases. If we add other open spaces that were discounted because of their limited accessibility, there is no doubt that they would form a global pattern. One possibility is that the axial break-up made by taking "the

Figure 4.51. City of London plan with 35 selected public spaces and convex isovists



fewest and longest axial lines that cover the convex spaces" is not the most suitable representation for modelling public spaces and might have to be rectified in the light of pedestrians' routes that the present axial model does not cover. This will be reviewed in the following chapter.

Effective space representation; results summary:

- All lines that interface with the effective space are above the mean integration values of the urban system, and 48% are part of the 10% integration core.
- For 6 out of 12 cases, all axial lines that interface with the effective space are within the 10% integration core.
- For one case only, the integration value of the effective space is within the 10% integration core.
- For all cases, the integration value of the effective space is above the mean integration value of respective towns.
- The global integration value of the effective space is independent of its size.

4.5.3.3. Comparing convex container and effective space representations

The analysis shows for both representations, that the axial lines which interface with the public spaces are also part of the most integrated ones of the system. In practical terms, this means that in both cases, public spaces are highly accessible and therefore likely to be an integral part of pedestrians' daily routes. However, the decrease in the number of axial lines intercepting with the effective spaces (in comparison with the convex container representation), affected their integration value. Consequently, globally they are less integrated spatial elements compared to the convex container.

4.6. DISCUSSION AND CONCLUSIONS

The first question that this chapter aimed to answer was whether public spaces in the City of London share morphological characteristics regarding accessibility and visibility from the urban fabric. The second question was, if there are common morphological characteristics for the public spaces of the City, are they present in the sample of traditional urban squares.

The public spaces in the City of London were, therefore, analysed according to two types of representations: the convex container (for comparison with the European sample) and the effective space.

For both representations of the City of London, many morphological characteristics were identified for the three types of analysis as summarised at the end of each sub-section. In addition, the comparison between the two types of representations (at the end of each section) has given an initial picture of the implications when representing the public space as a "convex container" or as an "effective space". There are some obvious differences, such as the area of the "public space" (the convex container or the effective space), the area of the isovist or the number of interfacing axial lines. However, there are a large number of common properties. Some of the most important ones include the positive relationship between the size of the public space and the strategic value, no relationship with the integration value of the main line, and the high percentage of axial lines interfacing with the public space in the 10% integration core of the system.

These findings suggest that despite the conceptual difference between the adopted representations, a comparison between them is valid and enlightening. One critical aspect, the fact that the effective space is smaller than the convex container, illustrates the outcome of modern interventions at urban level. For example, the provision of designated spaces for vehicular movement (streets) and pedestrian movement (pavements) meant a reduction of space available for static activities.

To answer the second question, the findings for the main convex element of traditional squares (all 30 cases)[36] are compared with the convex container representation of the contemporary cases in the City of London. To continue with the same methodology employed so far, the discussion will be carried out firstly for the convex and isovist analysis, followed by the interfacing axial lines and finally for the embedding analysis. Tables 4.14 to 4.16 summarise the findings according to the three types of analysis. The column "European square core sample" is added as reference only[37].

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[36] The comparative analysis will concentrate on the whole sample (30 cases) since, from Chapter 3, it has been suggested that there is no statistical difference between the results for the core and whole samples.

[37] In Table 4.14, "Space area – isovist area: Yes" (as an example) means that there is a correlation between the area of the (convex container, for instance) and its respective isovist area. The same terminology is applied in Tables 4.15 and 4.16.

Initially, comparing the size of the main convex element and the convex container (Table 4.14) we can observe a decrease between the two types of representations. The mean area for the City of London convex container is more than half the size of the main convex element of the European sample. Yet, when studying the isovist areas, they are similar (there is no statistically difference between the two[38]). This becomes more meaningful when we examine the visibility ratios. The visibility ratio for the convex container representation is more than twice as big as the main convex one. A strong indication of this trend is found when looking at individual cases. In the sample of traditional squares, 80% of all cases had a (low) visibility ratio, between 1 and 4. This number decreases to 33% for the convex container representation (ie, 67% had values greater than 4). Despite the increase of the isovist areas in relation to the convex container areas, for both representations there is a clear positive relationship between the two variables, which also includes a positive relationship with the isovist lengths.

Conversely, the enclosure property assumes a very distinctive character in comparison to the visibility property. Although the convex container representation has a slightly bigger enclosure ratio, for both representations there is no relationship between the size of the convex space (main convex element and convex container) and the enclosure ratio.

parameters	European squares core sample (16 cases) Main convex element representation	**European squares whole sample (30 cases) Main convex element representation**	**City of London sample (12 cases) Convex container representation**	**City of London sample (12 cases) Effective space representation**
Area of space (m^2)	5502	6073	2188	1593
Area of convex isovist (m^2)	14457	15671	15248	10851
Visibility ratio	2.99	3.07	7.13	13.75
Enclosure ratio	1.57	1.70	2.05	1.73
Sum length isovist - total (m)	833	882	1362	1029
Sum length isovist - select(m)	n/a	n/a	937	757
Sum length isovist - special(m)	n/a	n/a	1028	763
Mean length isovist - total(m)	118	125	144	123
Mean length isovist - select(m)	n/a	n/a	174	141
Mean length isovist - special(m)	n/a	n/a	184	152
Space area - isovist area	Yes	Yes	Yes (weak)	No
Space area - sum isovist length	Yes	Yes	Yes (weak all cases)	No (all cases)
Space area - sum mean isov.length	Yes (weak)	Yes (weak)	Yes (weak all cases)	No (all cases)
Space area - enclosure ratio	No	No	No	No

Table 4.14. European and City of London samples comparative data – isovist and convex analysis

[38] The t-test was applied with the result: t value = 0.097, p = 0.9236.

For the interfacing axial lines analysis, despite the small reduction in the number of axial lines and intersection points between the convex container and the main convex element, the analysis of the different types of axial lines showed that for both cases there is predominance of convergent axial lines interfacing with the "convex space". Not only are they the majority in number[39] but also in the frequency distribution amongst the cases for each sample (see Table 4.15). As far as the location of intersection points is concerned, in both cases there is a clear incidence bias for the edges of the convex space.

More significantly, the morphological study showed that the connection between public spaces and the urban environment works on a multiplicity of syntactic elements rather than any unique dominant factor. For both cases, there is a good positive correlation between the area of the convex space and the number of axial lines, sum of the length of the axial lines, intersection points and most importantly the strategic value.

parameters	European squares core sample (16 cases) Main convex element representation	European squares whole sample (30 cases) Main convex element representation	City of London sample (12 cases) Convex container representation	City of London sample (12 cases) Effective space representation
Mean n° axial lines/space	5.5	5.3	4.17	2.58
Mean n° intersection pts/space	5.43	5.17	3.9	1.5
N° (C) axial lines in sample	15/16	27/30 (90%)	10/12 (83%)	7/12 (58%)
N° (T) axial lines in sample	5/16	12/30 (40%)	6/12 (50%)	10/12 (83%)
N° (P) axial lines in sample	13/16	21/30 (70%)	8/12 (67%)	4/12 (33%)
Space area - sum n° axial lines	Yes (weak)	Yes (weak)	Yes	Yes
Space area - sum length ax. lines	Yes	Yes	Yes (weak)	Yes
Space area - mean length ax. lines	Yes (weak)	Yes (weak)	No	No
Space area - strategic value	Yes (weak)	Yes (weak)	Yes	Yes
Space area – local strategic value	Yes (weak)	Yes (weak)	Yes	Yes
Space area - in main line	No	No	No	No
Isovist area – sum length axial lines	Yes	Yes	Yes	No
Space area - intersection points	Yes	Yes	Yes	No

Table 4.15. European and City of London samples comparative data – interfacing axial lines analysis

The embedding analysis (Table 4.16) showed that for both representations, the axial lines that interface with the convex space are all well integrated in relation to the other lines of the system. This is an important finding (mainly regarding the convex container representation) because the axial map is much larger in terms of number of axial lines compared to any of the European cities. In the sample of traditional squares, the majority (87%) of all cases had at least one axial line in the main integration core, For the City of London convex container representation, the percentage is also very high

[39] Convergent axial lines represent 65.4% of all lines for the main convex element representation (whole sample) and 58% for the convex container one. Refer to Tables 3.10 (Chapter 3) and 4.12 respectively.

with 75%. In both cases, all lines intercepting with the convex space are above the mean integration values of the system.

Despite the high number of axial lines in the integration core, public spaces are not highly integrated spatial elements in comparison to the axial lines of the system, and this has mixed results. For the main convex element representation, 23% belong to the 10% integration core, and an additional 54% are located in the secondary integration core. For the convex container representation, 50% are present in the 10% integration core and 50% in the secondary one.

Parameters	European squares core sample (16 cases) Main convex element representation	European squares whole sample (30 cases) Main convex element representation	City of London sample (12 cases) Convex container representation	City of London sample (12 cases) Effective space representation
% spaces with at least 1 axial line in the 10% integration core	87	87	75	75
% of lines integration core	50	55	60	48
% of lines above mean integration	85	89	100	100
Rn space: % integration core	30	23	50	08
Rn space: % above mean integration	81	77	100	100
Space area - Rn value space	No	No	No	No

Table 4.16. European and City of London samples comparative data – embedding analysis

In summary, comparing both convex representations, despite the reduction of area in the City of London cases (and consequently a decrease in the number of axial lines), the relationship between the "urban square" (the main convex element or the convex container) and the visual and access links with the urban environment are all the same[40]. The larger the urban square, the larger and longer the visual links. The larger the urban square, the larger the strategic value (also the number and length of the axial lines). Also, urban squares prioritise "to-movement" and the vast majority of axial lines that cross the urban square belongs to the 10% most accessible places of their respective towns.

Finally, effects of modern interventions are identified when comparing the spatial characteristics of the effective space (public spaces in the City of London) to the main convex element (urban squares of European towns). There are two major differences. The first difference is regarding the visibility properties. Public spaces in the City of London have, proportionally, much larger and longer isovists than their European

[40] There is only one exception, which is the correlation between the size of the convex container and the mean axial line length, as illustrated in Table 4.15.

counterparts. In addition, for the public spaces in the City of London, there is no relationship between their area and respective isovists (this also includes the isovists' length for all methods of quantification) and length of the axial lines and isovist areas, whereas this correlation is found in the European sample. The second major difference relates the properties of the axial lines that cross the public space. Firstly, the number of axial lines and intersection points is smaller for the City of London public spaces. Also, there is an important difference in the way axial lines intercept with the public spaces. The public spaces in the City are dominated by transverse axial lines, in contrast to the traditional urban squares where convergent axial lines are predominant. Although there is a smaller number of axial lines intercepting the City of London public spaces, they are comparatively more integrated than the traditional squares in relation to the remaining axial lines of the system.

Therefore, the study was able to identify common morphological characteristic for the City of London cases regarding accessibility and visibility connections to the urban environment, and many of these properties were also found in the sample of traditional square of European towns. How do these properties affect the level and distribution of static people in public spaces? This question will be addressed in the next two chapters.

5

CITY OF LONDON PUBLIC SPACES: LEVELS OF PEDESTRIAN MOVEMENT AND STATIC OCCUPANCY

The main objective of this chapter is to study which spatial properties common to the sample of public spaces in the City of London lead to good levels of static occupancy. As a prelude, levels of pedestrian movement will be studied in relation to the configuration of the urban fabric. The aim is to examine to what extent there is an association between levels of static occupancy and levels of pedestrian movement inside public spaces. This chapter is divided into three main sections. The first section analyses levels of pedestrian movement. The second section analyses the levels of static occupancy. Lastly, the relationship between the two is examined.

5.1. LEVELS OF PEDESTRIAN MOVEMENT

This first section centres on the empirical determination of levels of pedestrian movement inside the selected public spaces and in their surrounding areas. In this respect, an analysis will be undertaken to investigate whether the syntactic properties established for linear spaces (ie, streets), such as the relationship between numbers of moving people and integration values of axial lines[1], can also be found for movement

[1] Based on the theory of natural movement (Hillier et al., 1993a).

patterns inside public spaces. Using direct observation to collect empirical data on levels of pedestrian movement will enable an evaluation of the performance of the selected spaces in the City of London. In Section 5.1, after presenting the data collected during the fieldwork, an ethnographic description of levels of pedestrian movement inside the selected public spaces is given, which describes the similarities and differences amongst the cases. The data on pedestrian movement will then be analysed.

5.1.1. DESCRIPTION OF FIELD WORK

One of the adopted criteria for evaluating the success of a public space is whether static people use the space throughout the day, including outside the "standard" working hours (from 9 am to 5 pm).

The number of hours for collecting the empirical data on patterns of spatial use of public spaces was based on a study by Space Syntax Laboratory (Hillier et al. 1995b). For a research project on the redevelopment of the commercial area in Croydon, south London, static people were observed on a shopping street and in a public space (there were no catering facilities nearby) from 8 am until 10 pm. The numbers of static people (adults) for the public space and main shopping street were very similar to each other. Most significantly, although the majority of people (41%) were using the public space during lunchtime, 3% were using the public space between 8 am – 10 am and from 6 pm to 8 pm. In addition, the work on public spaces by Burden (1977) and Whyte (1980) also provided evidence that public spaces can be effectively used for long periods during the day. The time periods were based on a feasibility study by Space Syntax Laboratory (1996d) on the development of the Baltic House Site. During this study, research was done to identify the pattern of pedestrian movement in the City of London throughout the day. Moving people were counted almost continuously over a twelve-hour period. From the collected data, six time periods were identified.

The selected public spaces[2] were, therefore, observed from 8 am to 8 pm divided into six time periods, as follows: 8:00 - 9:20 am (early morning peak), 9:40 - 11:50 am (mid-morning period), 12:00 - 2:10 pm (lunchtime or midday peak), 2:20 - 4:40 pm (mid-afternoon period), 4:50 - 6:10 pm (early evening peak) and 6:20 - 8:00 pm (early

[2] The term "public space" means the effective space as defined and discussed in Section 4.4.1.2, Chapter 4. Therefore, static people on adjacent pavements and in other surrounding areas were not counted.

evening). The observations included the number of moving people within the public spaces and in the surrounding area, the number of static people within the public spaces, with additional information about their location and activities. Each individual technique will be discussed in detail in the relevant sections.

The number of moving people were quantified using the "gates" technique, with a two and a half minute time observation for each gate, or longer when required[3], from the 12th August to the 3rd September 1996[4]. Each gate was observed twice per time period (12 times in total). Gates were placed at all entrances to the open spaces, inside the public spaces and in their surrounding area (referred to as "street" gates). There was a classification of moving people according to gender, but the study was restricted to City workers[5]. In total, 193 gates were observed[6]. This data provided quantitative information on the density of pedestrian movement in both streets and public spaces in the City of London. The location of the observation gates is illustrated in Plate 5.1 with the results in Table 5.1 (both in Appendix 3). Table 5.2 contains a summary of data used for this study and is also found in Appendix 3.

The data is presented for the mean number of people per hour (pph) according to time periods or for the whole day (8 am to 8 pm), depending on the research question.

5.1.2. CITY OF LONDON PUBLIC SPACES: DESCRIPTION OF LEVELS OF PEDESTRIAN MOVEMENT

The data showed that public spaces could be divided into three groups according to the mean number of moving people crossing the public space. The first group is made

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[3] The gate method is a well-established technique used for recording data on moving people. "The procedure is to stand at each gate position and draw an imaginary line crossing the street space (that is, at right angles to the direction of the street). People or vehicles are then counted crossing this line for a set period of time, usually 2 1/2 or 5 minutes...In suburban areas or any area with low rates of movement, count five minutes per gate". Refer to Observation Procedures, 1997-98, p1.

[4] The mean temperature for this period was 19.5 ^{o}C. Data provided by the Meteorological Office.

[5] Children, tourists and construction workers were excluded from the analysis because their number was very small and restricted to a few gates.

[6] Note that often "street" gates were allocated for more than one public space. For instance, when assessing the number of moving people for North Guildhall surrounding area, some of the street gates illustrated for Love Lane Corner (Fig. 7, Plate 5.1, Appendix 3) were also used in its analysis, although not shown in Figure 9, Plate 5.1 (Appendix 3).

up of public spaces where the mean number of people crossing is less than 100 pph[7]. St. Anne & St. Agnes churchyard has the lowest number of moving people in the whole sample (11.33 pph), followed by three public spaces with very similar numbers: Love Lane (42.67 pph), Abchurchyard (54.00 pph), and New Change/Cheapside Corner (56.00 pph). The second group is made up of those public spaces with a number of moving people ranging from 101 to 500 pph. They are Whittington Gardens (108.00 pph), Fleet Place (221.00 pph), Bank Corner (264.67 pph), North Guildhall (324.00 pph) and finally Fenchurch Place with a mean of 480.67 pph. The third group is composed of the public spaces with a mean number of more than 500 pph. They are Royal Exchange (547.00 pph), Exchange Square (572.40 pph) and Finsbury Av. which has the highest number at 630.33 pph. These results are summarised in Table 5.3.

Public space name	Mean n° moving people inside public space/hour	Mean n° moving people outside public space/hour	Ratio between n° mov. people outside and inside public space
Abchurchyard	54.00	673.40	12.47
Bank Corner	264.67	1389.56	5.25
Exchange Square	572.40	521.86	0.91
Fenchurch Place	480.67	928.31	1.93
Finsbury Av.	630.33	828.89	1.32
Fleet Place	221.00	418.46	1.89
Love Lane Corner	42.67	335.50	7.86
New Change/Cheapside Corner	56.00	1084.80	19.37
North Guildhall	324.00	403.60	1.25
Royal Exchange	547.00	882.00	1.61
St. Anne & St. Agnes churchyard	11.33	362.00	31.95
Whittington Gardens	108.00	793.56	7.34
MEAN ALL CASES	350.06	727.62	7.76

Table 5.3. Levels of pedestrian movement for public spaces and surrounding areas

The ratio of pedestrian movement between inside and around public spaces varies substantially (Table 5.3). For instance, in Exchange Square the levels of pedestrian movement outside and inside had virtually the same profile, with a ratio close to 1, compared to St. Anne & St. Agnes churchyard with a ratio of 31.95. Plate 5.2 illustrates the levels of pedestrian movement in and around the public spaces, with the mean hourly rate (all day) printed in black.

[7] Because of the physical size of some of the public spaces, many gates had to be placed inside the space to collect the data on number of moving people. Naturally, the bigger the public space, more people will be counted because more gates were organised. In order to overcome this problem, for the analysis of moving people inside the public spaces, the mean number of moving people was calculated by summing the total number of moving people per hour divided by the total number of gates. All gates were placed inside the public squares and each gate covered one convex space of the public space.

Plate 5.2. Pedestrian movement frequency distribution on weekday (1/2)

mean all day scale: 1:4000

hourly rate: 2001 or more; 1001 to 2000; 501 to 1000; 251 to 500; 101 to 250; 100 or less

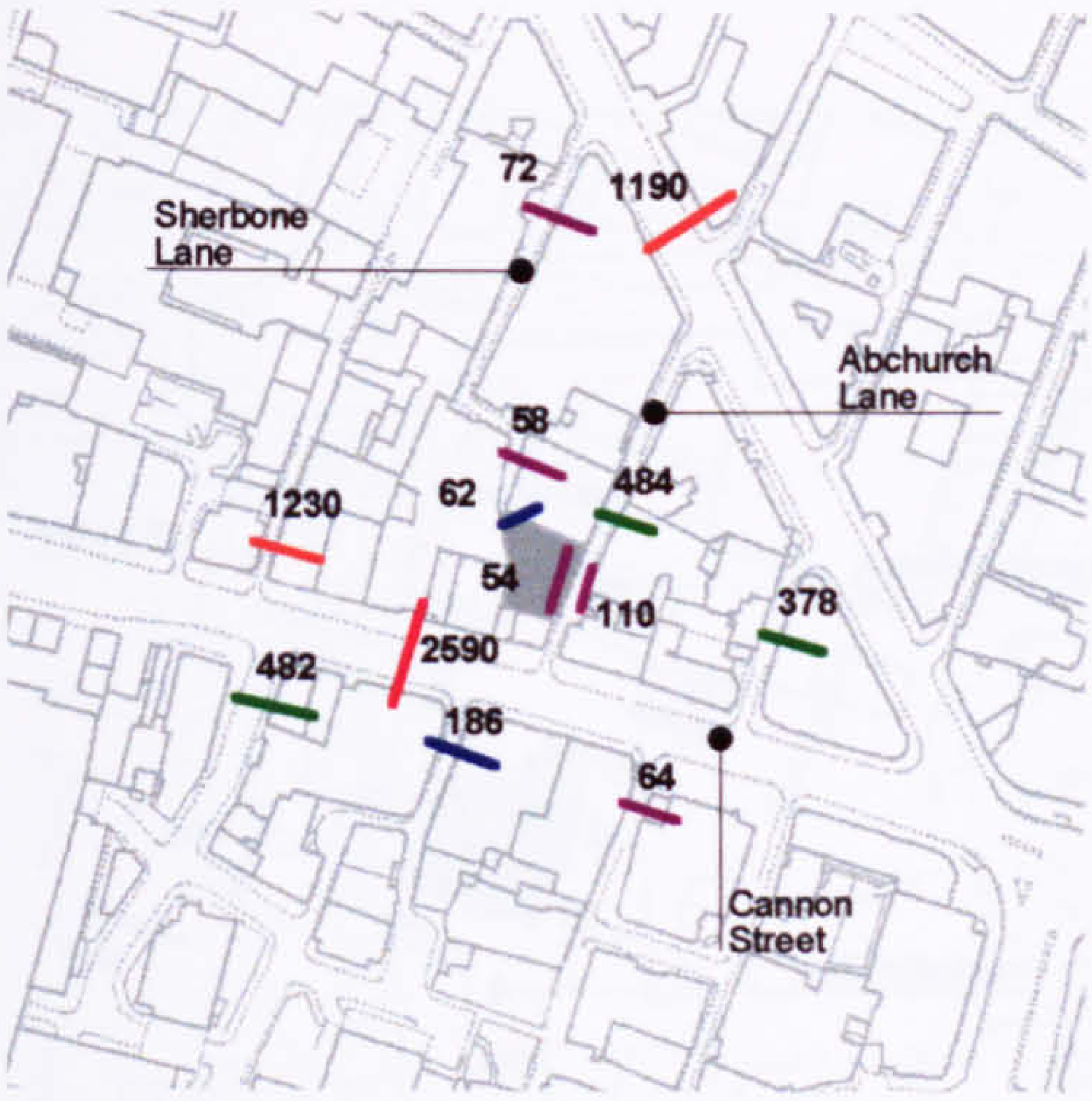

Fig. 1. Abchurchyard

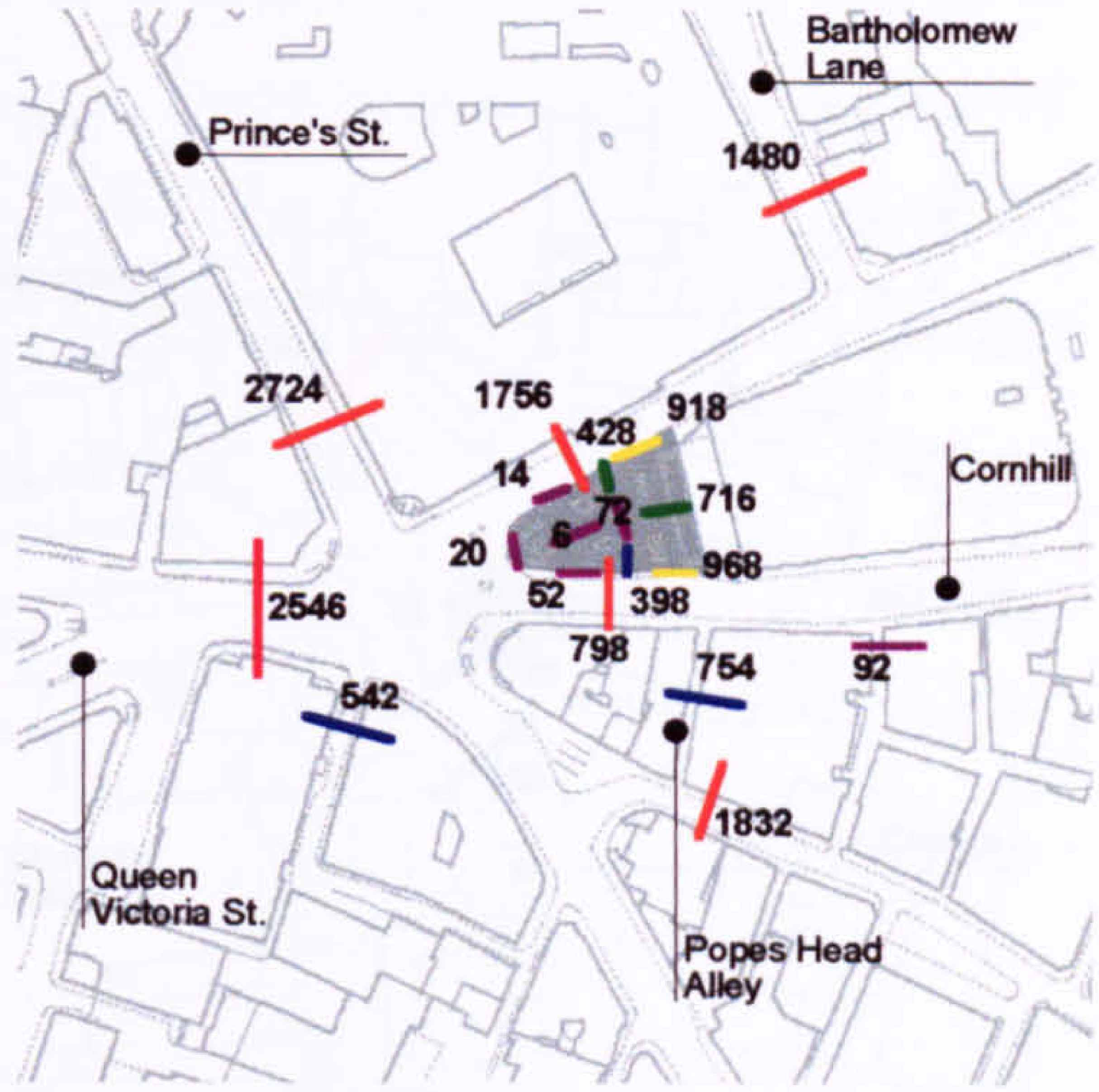

Fig. 2. Bank Corner

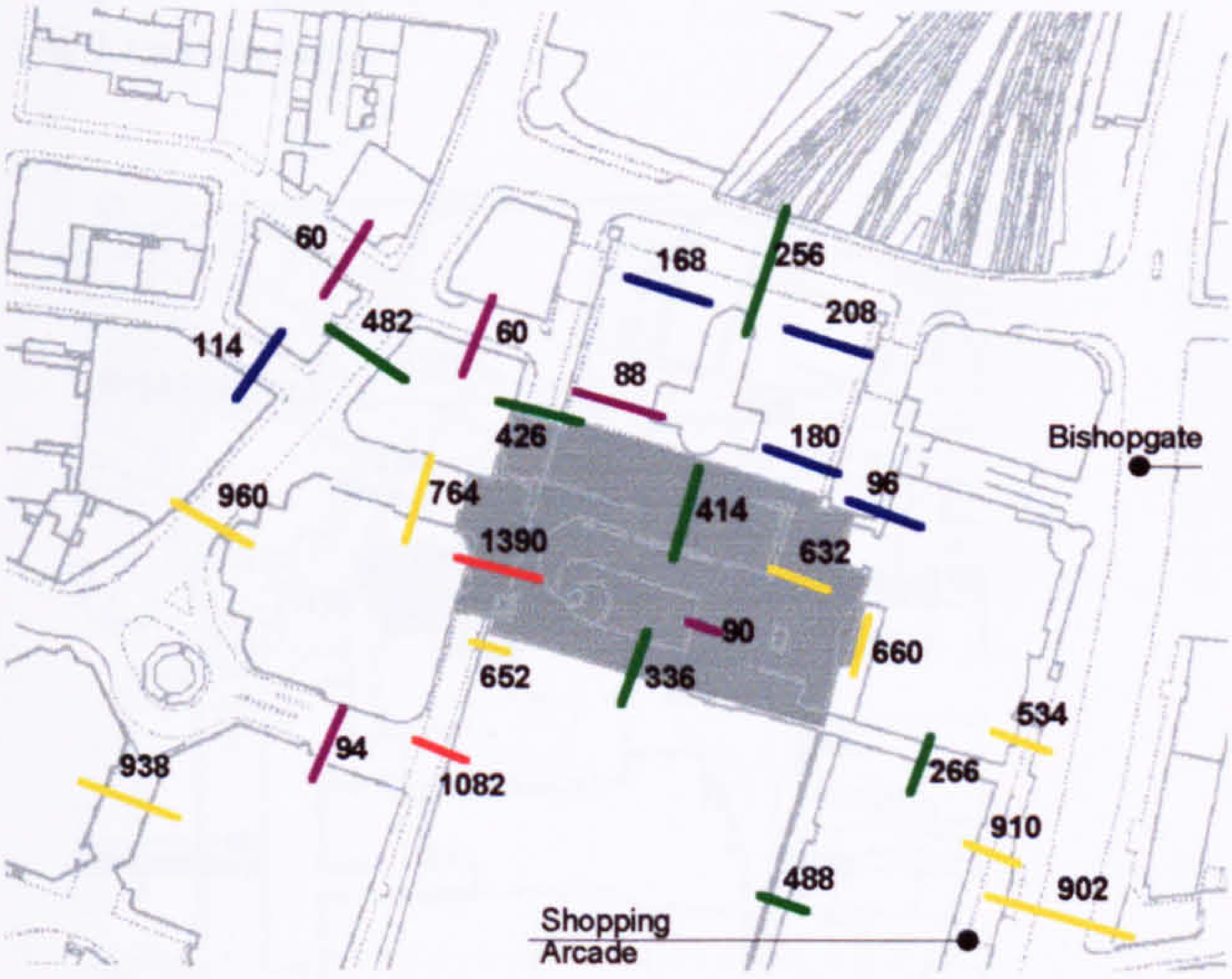

Fig. 3. Exchange Square

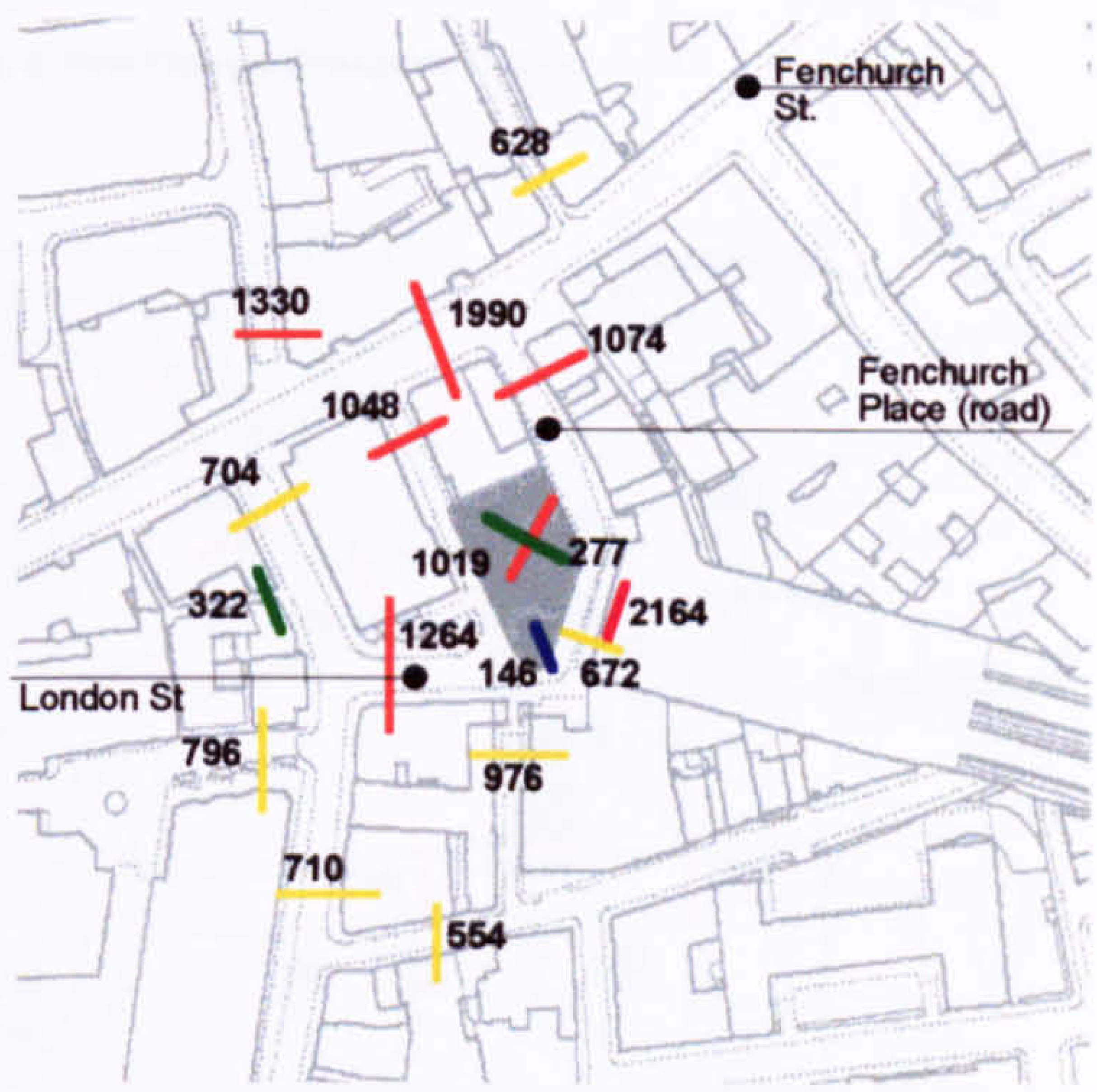

Fig. 4. Fenchurch Place

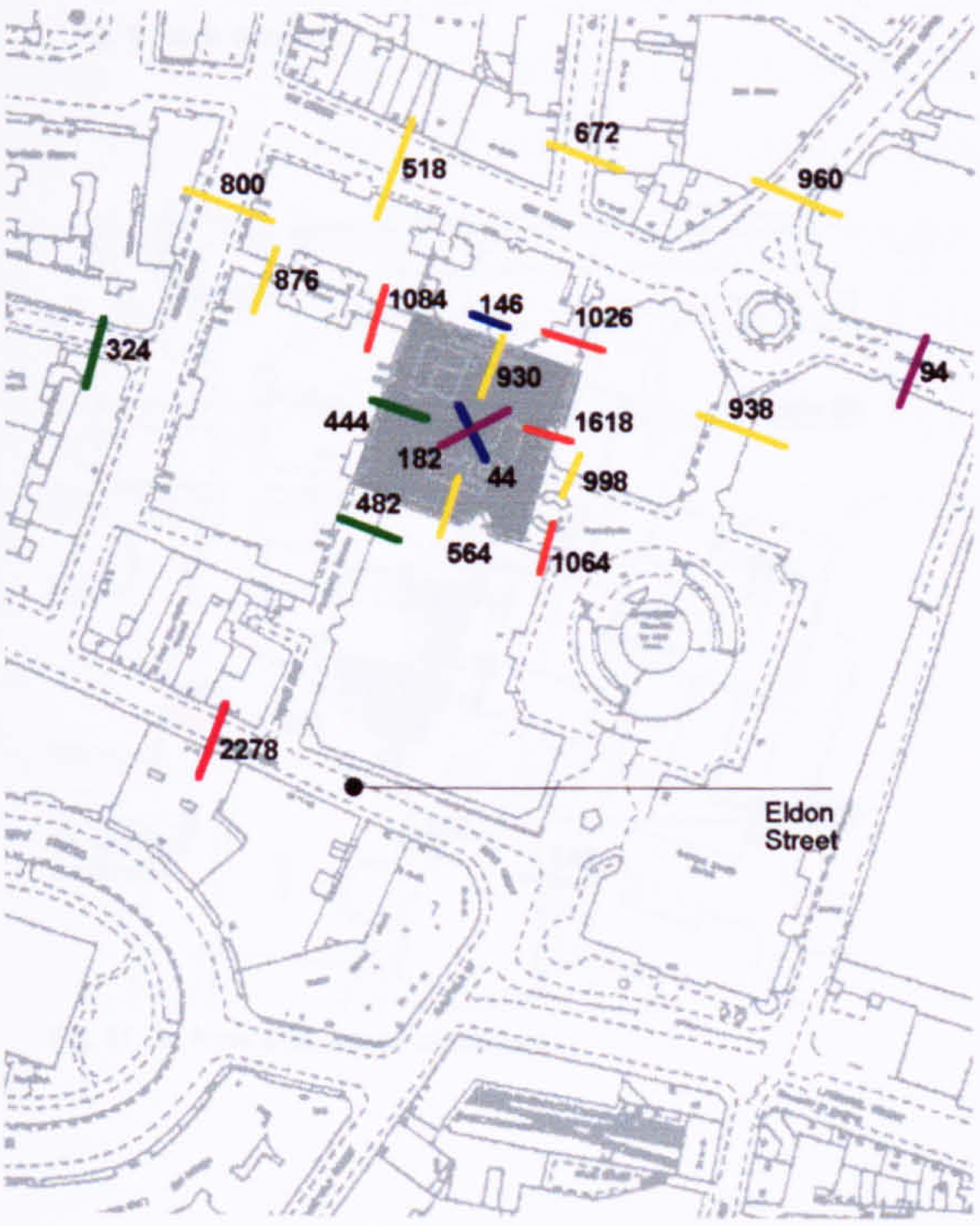

Fig. 5. Finsbury Av.

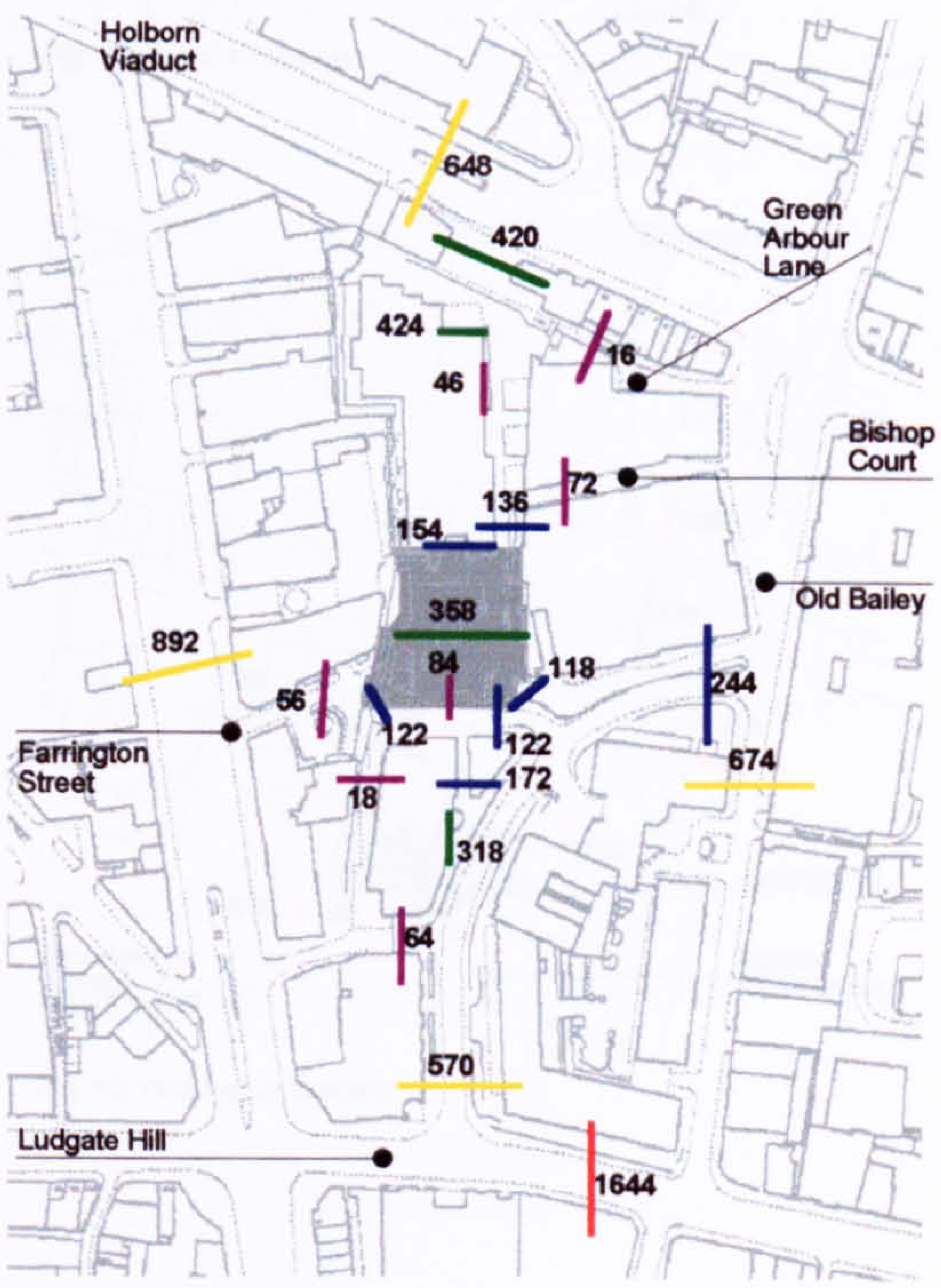

Fig. 6. Fleet Place

Plate 5.2. Pedestrian movement frequency distribution on weekday (2/2)

mean all day scale: 1:4000

hourly rate: 2001 or more; 1001 to 2000; 501 to 1000; 251 to 500; 101 to 250; 100 or less

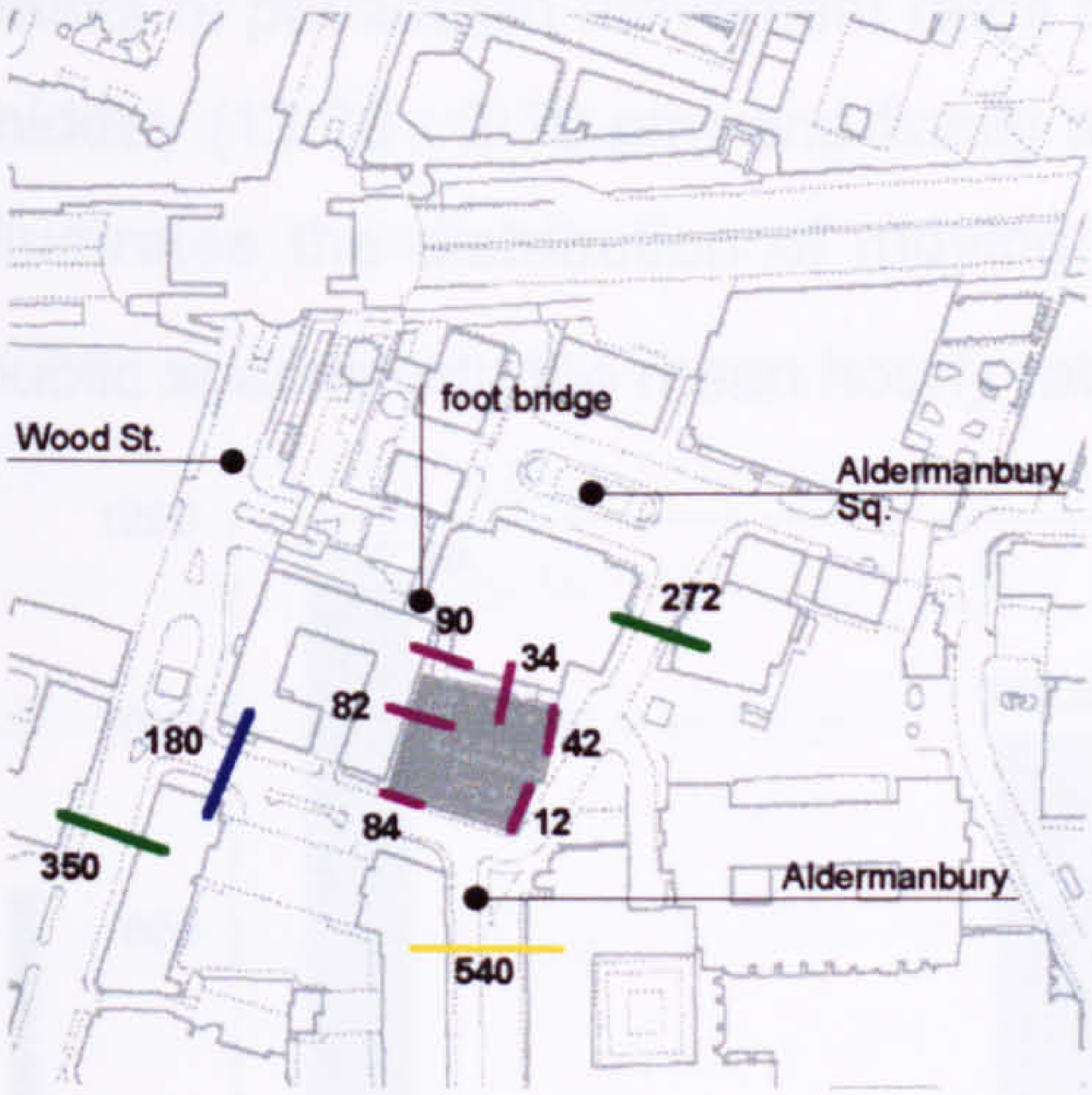

Fig. 7. Love Lane Corner

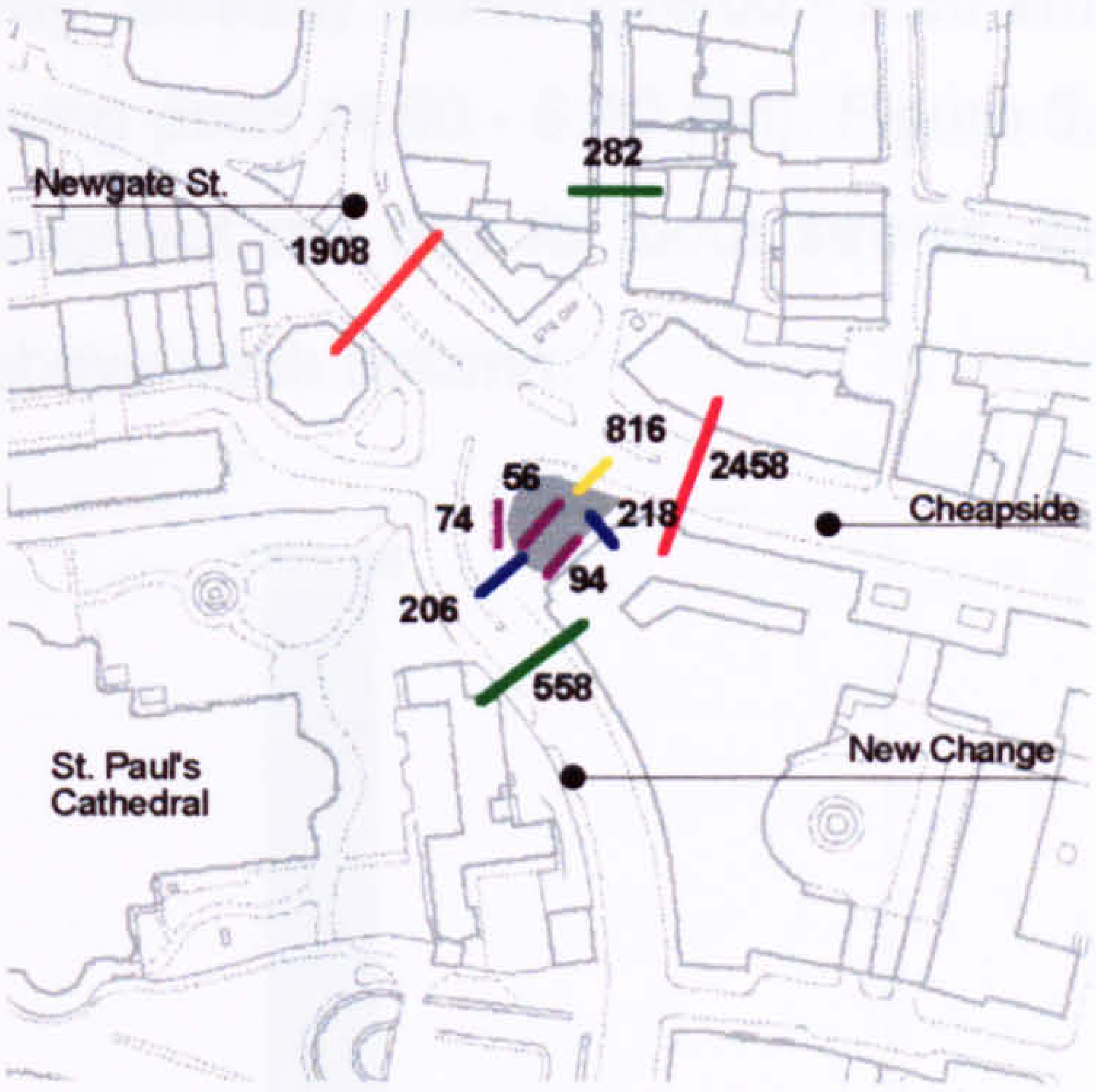

Fig. 8. New Change/Cheapside Corner

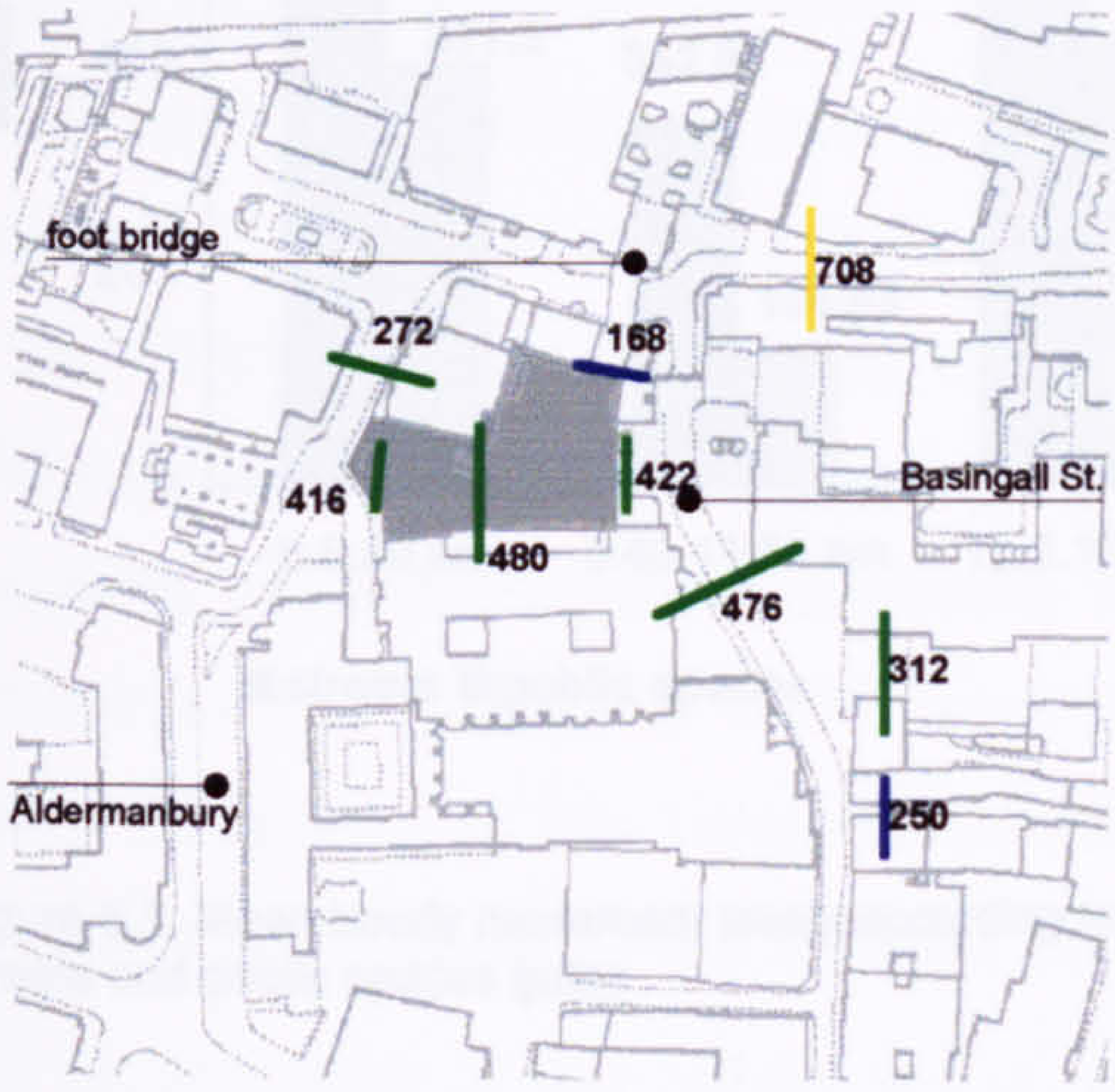

Fig. 9. North Guildhall

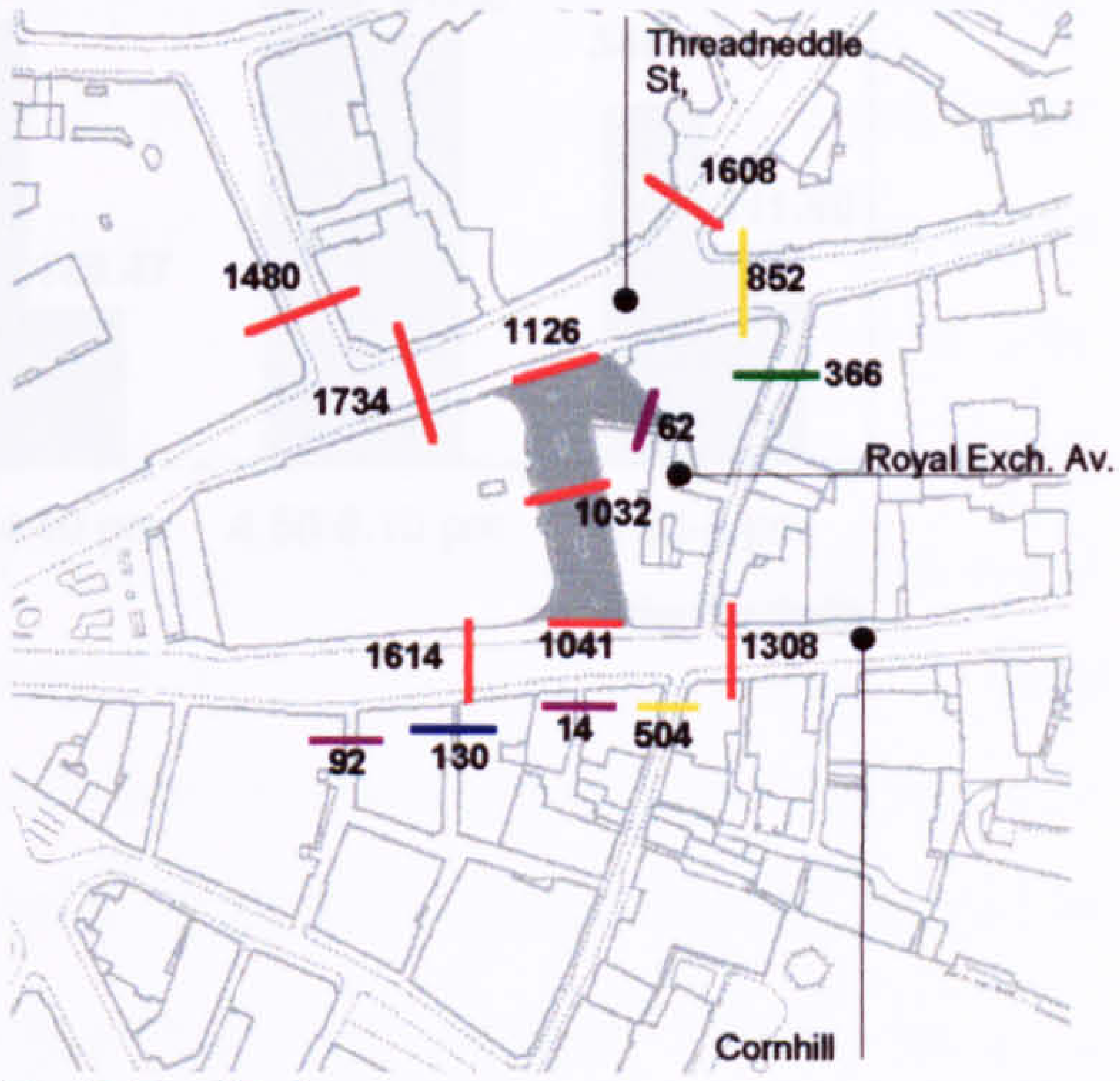

Fig. 10. Royal Exchange

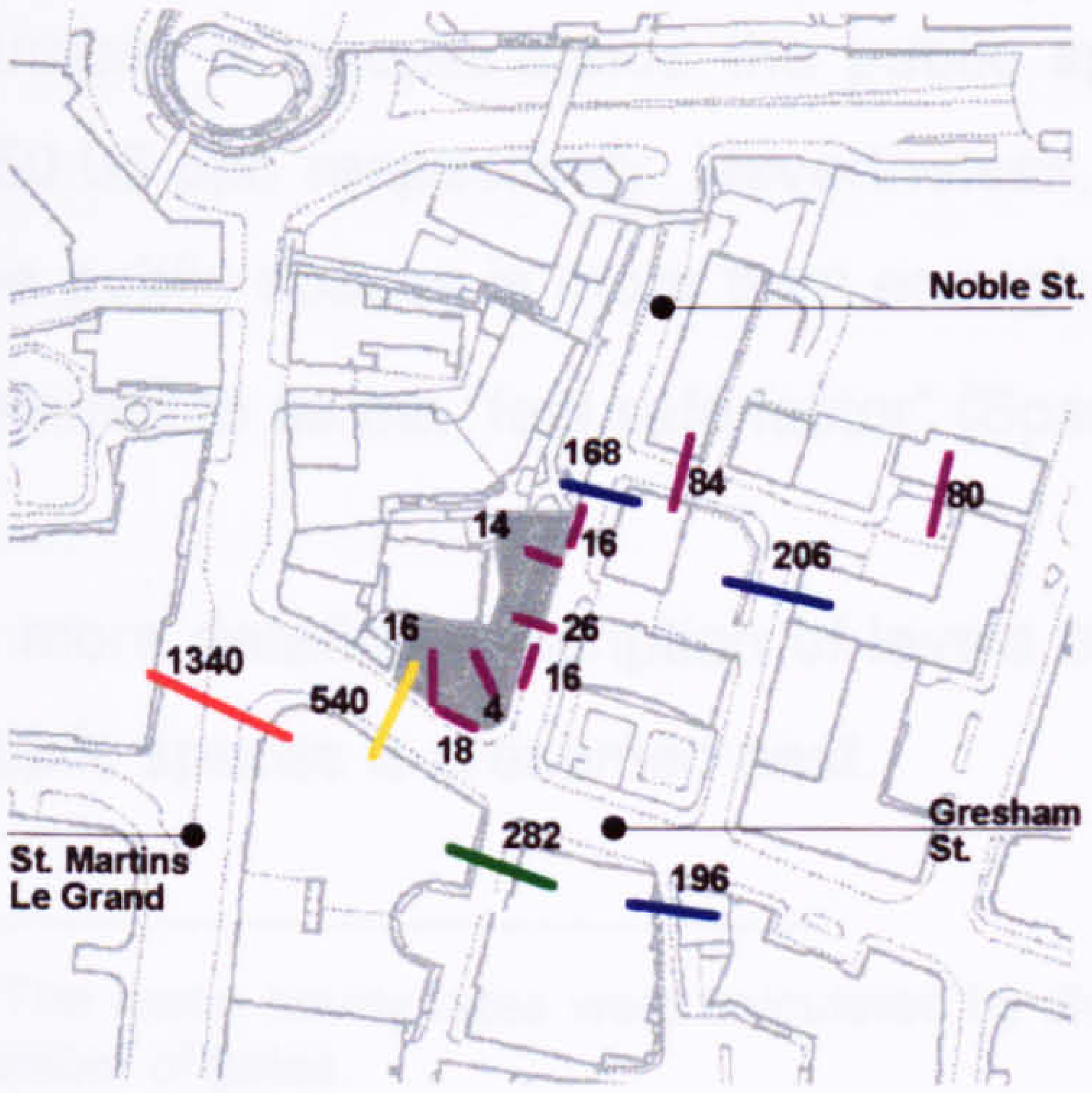

Fig. 11. St. Anne & St. Agnes churchyard

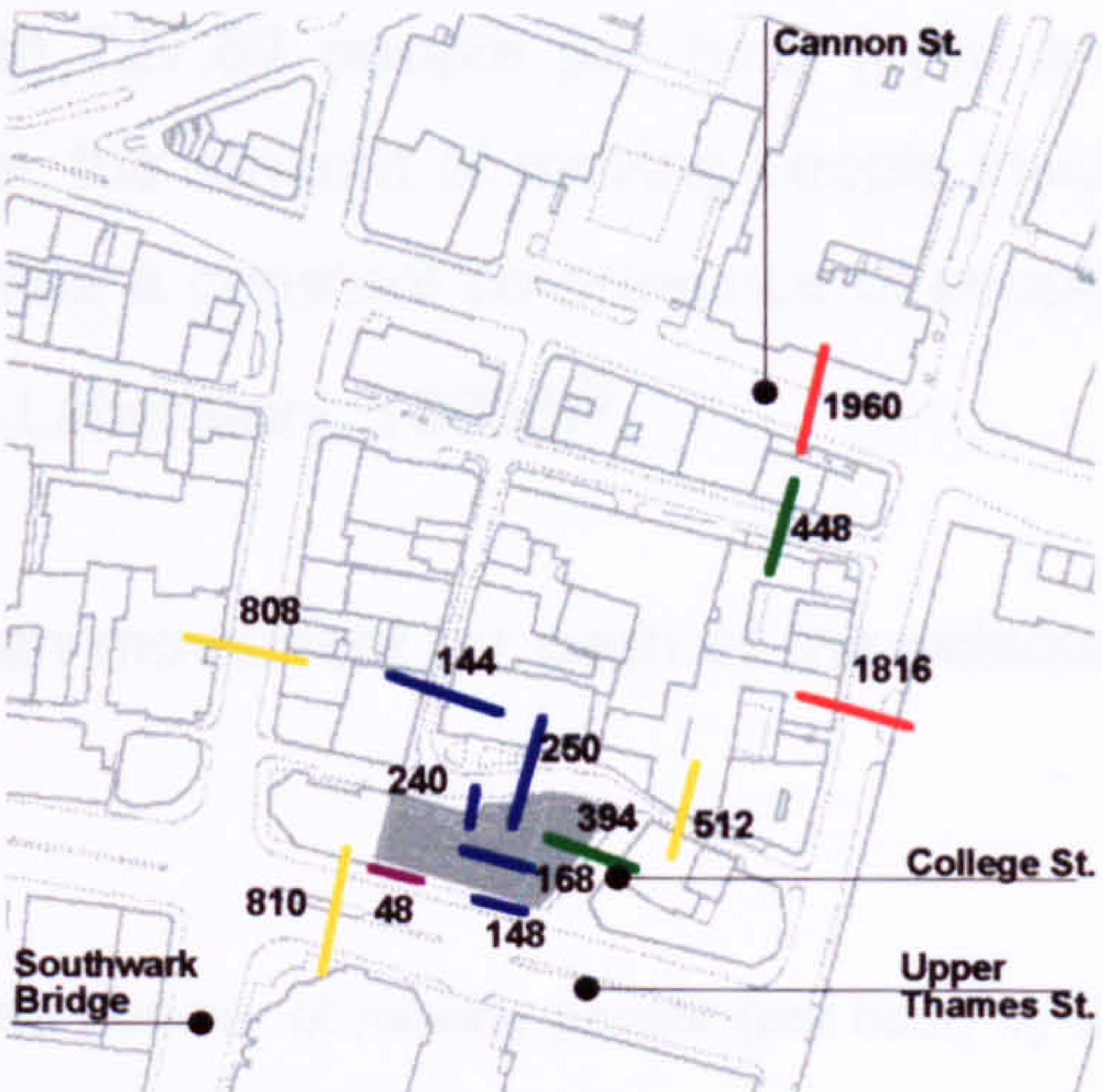

Fig. 12. Whittington Gardens

The empirical data collected on patterns of pedestrian movement in the City of London showed some interesting trends. For both streets and public spaces there are three peaks of pedestrian movement rates during the day: an early morning (8:00 - 9:20 am), midday (12:00 - 2:10 pm) and finally an early evening peak (4:50 - 6:10 pm). Figure 5.1 illustrates the distribution of moving people throughout the day for both streets and public spaces with the mean hourly rate[8] printed above each column.

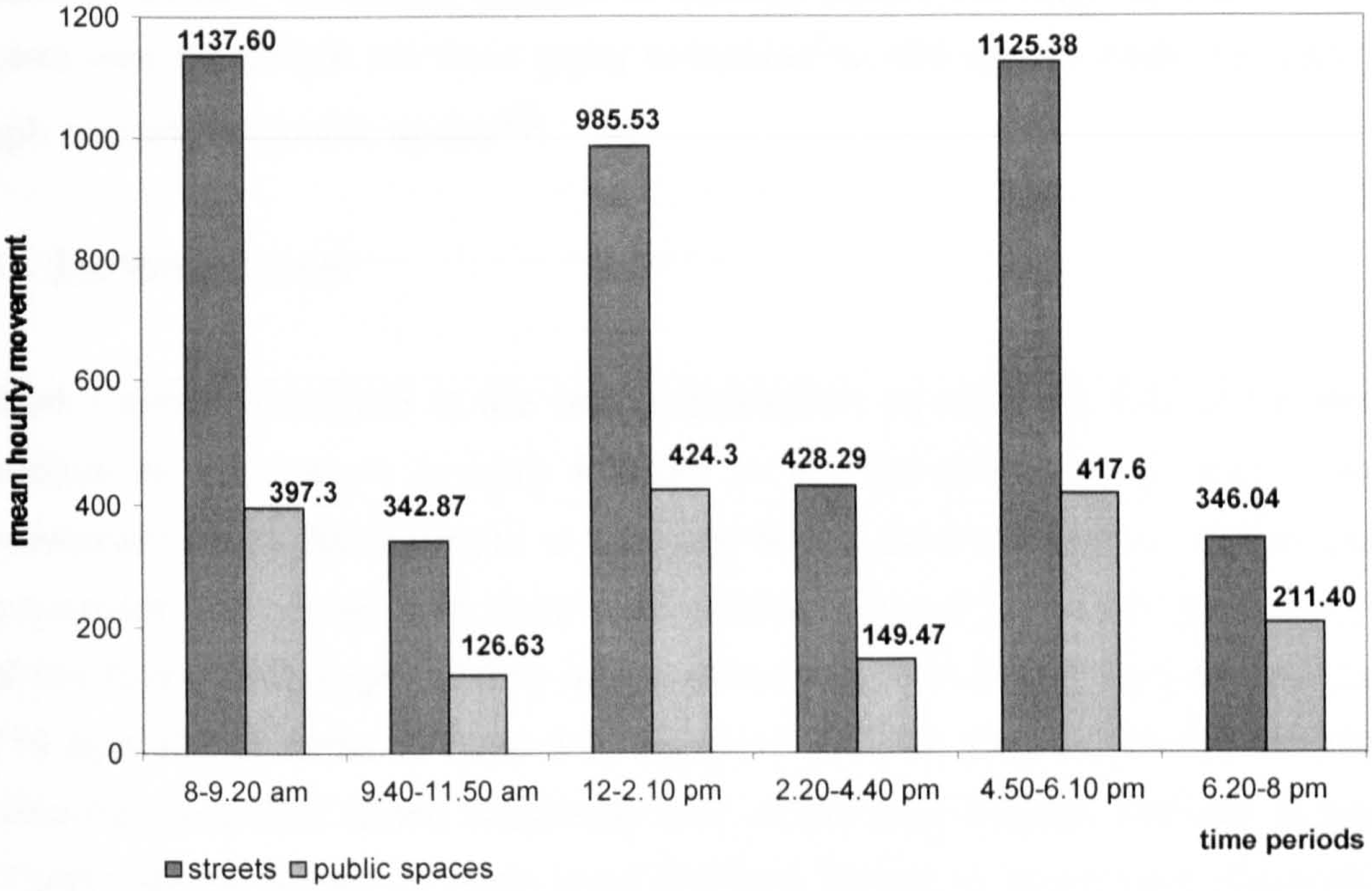

Figure 5.1. Mean hourly movement levels according to streets and public spaces gates

Although both streets and public spaces share the same pedestrian movement profile, the mean number of moving people all day on streets is almost twice as high as the number of people inside the public spaces, with 727.62 people per hour (pph) and 350.06 pph respectively. Nevertheless, in general, the amount of moving people inside the public spaces is more than enough to guarantee a constant co-presence of people, referred to as the "feel safe factor" (Space Syntax Laboratory, 1996d)[9].

A more detailed description of levels of pedestrian movement for each of the selected public spaces is presented next.

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[8] The mean hourly rates were calculated by dividing the total number of moving people (per hour) by the number of gates.

[9] According to a study by Space Syntax Laboratory, "2 to 3 people per minute/120 to 180 pph [is necessary] to guarantee more or less constant co-presence with more than one other person – the "feel safe factor" for pedestrian movement" (Space Syntax Laboratory, 1996d, p4).

5.1.2.1. Abchurchyard

The main flow of pedestrian movement in the immediate area occurs adjacent to the public space via Abchurchyard Lane (refer to Plate 4.1, Appendix 2). Pedestrian movement inside the public space is basically limited to local City workers who are located in office buildings at Sheborne Lane, who cross the public space to reach Cannon Street. The mean number of moving people (all day) recorded in Sheborne Lane was 58 people per hour (pph) compared to 484 pph in Abchurch Lane and 54 pph crossing the public space[10].

5.1.2.2. Bank Corner

Bank Corner is located at the main intersection point in the City of London where pedestrian movement is very intense in all directions. In contrast, pedestrian movement inside Bank Corner is basically limited to one direction, that is, pedestrian movement that comes from Pope's Head Alley, crosses the public space by the steps of the Royal Exchange building and continues north towards Bartholomew Lane with 716 pph all day (refer to Plate 4.2, Appendix 2). The potential pedestrian movement crossing the public space diagonally from south east (Queen Victoria) to north west (Threadneedle Street) or north west (Prince's Street) to south east (Cornhill) is very small compared to the levels of pedestrian movement in the immediate vicinity. For instance, in Prince's Street a mean of 2724 pph was recorded, compared to 72 pph in the central area of the public space, well below the "feel safe factor"[11]. The level of pedestrian movement drops even further on the south west side (Fig. 2, Plate 5.2), where only 6 pph were recorded crossing the public space (the lowest rate for all gates of the sample). While the level of pedestrian movement in Pope's Head Alley and along the Royal Exchange building is virtually the same, people approaching the public space from NE or SW sides, instead of crossing the public space which is in principle the shortest route, tend to divert their route and circumnavigate along the pavement towards their destination.

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[10] In this section, all rates for pedestrian movement is given for the mean of all day, unless otherwise stated.

[11] Ibid. 9.

5.1.2.3. Exchange Square

Pedestrian movement in the surrounding streets is not high, compared to other areas in the City. In Bishopsgate, which is the major traffic road in the area, 902 pph were recorded through the day, slightly above the sample mean of 728 pph (streets only) and lower than the 910 pph recorded walking along the shopping arcade of Bishopsgate Building (Fig. 3, Plate 5.2). However, the levels of pedestrian movement inside and outside the space are very similar. Exchange Square is the best example of the sample where the natural patterns of pedestrian movement in the area are maintained across the public space. In fact, a higher mean number of people were observed moving inside the public space (572.40 pph) in comparison to the mean number of moving people in the adjacent streets (521.86 pph). This is a very different situation to Bank Corner, where the mean number of moving people (streets only) is almost four times the mean number of people moving across the public space, as illustrated in Table 5.3.

5.1.2.4. Fenchurch Place

The main flow of pedestrian movement in the area is at Fenchurch Street where 1990 pph all day were recorded, one of the highest rates of pedestrian movement (streets only). Moving off Fenchurch Street, pedestrian movement drops, as expected, but generally it remains above the mean for the sample. In the two streets surrounding Fenchurch Place, London Street and Fenchurch Place (road), the recorded mean number was 1048 and 1074 pph respectively (Fig. 5, Plate 5.2). The high levels of pedestrian movement are partially explained by the sheer amount of people using Fenchurch Train Station (5112 and 4584 pph were observed leaving and entering the station at morning and afternoon peak periods), which has an entrance facing the public space. Therefore, during the morning and afternoon peak periods, the public space is mainly used as a transitional space between the train station and the area around Lloyds Building. The mean number of moving people inside the public space was 481 pph, the 4th highest of all twelve cases of the sample.

5.1.2.5. Finsbury Av.

Pedestrian movement in the immediate area is very mixed. In some areas it can be high, mainly at the south side of the public space by Eldon Street (2278 pph all day), which links Moorgate to Liverpool Street. However, in other areas movement rates are much lower. Finsbury Av. is located in an almost identical situation as Fenchurch Place in relation to Liverpool Street Train Station. Pedestrian movement follows a south-east to north-west pattern. People leave the train station, walk towards Finsbury Av., crossing the space, moving north towards Finsbury Square and adjacent areas. Subsequently, the level of moving people inside the public space can be very high, mainly during peak hours. In Finsbury Av., the highest number of moving people inside a public space was recorded with 1618 pph all day for the gate on the east side (Fig. 5, Plate 5.2), a number very close to the busiest streets in the City. The recorded number of moving people inside the public space for the other gates is also high, consequently the mean number of moving people inside the public space is 630.33 pph, the highest number recorded for all the public spaces of the sample.

5.1.2.6. Fleet Place

Pedestrian movement in the immediate area is quite variable, similar to the area around Finsbury Av. It is high on Ludgate Hill where 1644 pph were recorded (Fig. 6, Plate 5.2). The other three major roads, Farrington Street, Holborn Viaduct and Old Bailey have lower rates (892, 648, 674 pph respectively). One step away from the major access roads (which in fact are the streets that link them to Fleet Place) and the level of pedestrian movement drops dramatically, with some of the lowest rates recorded for the sample. In Green Arbour Lane, the observational data showed 16 pph, the second lowest movement rate of all streets observed in the study. The level of pedestrian movement in Bishop Court is 72 pph, and in the road that links Farrington Street to Fleet Place 56 pph were observed. On the access from Fleet Place building, only 18 pph were recorded. That gives a mean of 145 pph when the four major surrounding streets are omitted, a similar ratio when compared to the mean number of moving people inside the public space with 221 pph all day. When all the roads are included, the mean number of moving people around the area rises to 418.46 an hour. This illustrates quite clearly how much the levels of pedestrian movement drop only one step away from the major thoroughfares. The majority of people crossing the public space restrict themselves to its periphery rather than the central area. The only effective pedestrian movement that crosses through the middle of the public space is limited to the City workers based in a major office building on the north side of the public space (refer to Plate 4.6, Appendix 2).

5.1.2.7. Love Lane Corner

Pedestrian movement in the area is of medium intensity compared to other parts of the City. In Aldermanbury, south of Love Lane, the highest levels of pedestrian movement were recorded with 540 pph throughout the day, but in the other surrounding streets the levels of pedestrian movement is much lower. In Wood Street, which links London Wall to Cheapside, only 350 pph were recorded. In Aldermanbury, near Aldermanbury Square, the levels of pedestrian movement drop even further to 272 pph. The level of pedestrian movement inside the public space is lower than the mean ratio for the surrounding streets with a mean of 42.67 pph. In one particular direction (Fig. 7, Plate 5.2), only 12 pph were recorded, one of the lowest for all cases in the sample. The highest number of people recorded crossing the public space were found at the foot bridge that links the Barbican to Cheapside, where 90 pph all day were recorded. This type of movement characterises Love Lane as more of a destination place, with very little through movement, in contrast to public spaces such as Fenchurch Place and North Guildhall.

5.1.2.8. New Change/Cheapside Corner

Similar to Bank Corner, pedestrian movement here is very intense in all directions of this main intersection point formed by Cheapside, New Change, and Newsgate Street (Fig. 8, Plate 5.2). Conversely, pedestrian movement inside New Change/Cheapside Corner is very low and limited to one direction. The primary pedestrian movement is from St Paul's Cathedral, across the zebra crossing, and then through the public space towards the west of Cheapside. On Cheapside 2458 pph were recorded (the 4th busiest gate), with 4212 pph recorded at lunchtime which is very likely to be related to the "shopping" character of the street. On Newsgate Street, 1908 pph were recorded followed by 558 pph on New Change. In New Change/Cheapside Corner, we find the same phenomena already noted at Bank Corner, where pedestrian movement is very high in the adjacent streets, yet very low inside the public space. Only 56 pph were recorded crossing the public space during the day. Most significantly, there were 816 pph recorded along the pavement, between Cheapside/New Change "square" and Cheapside road. This illustrates very clearly that, instead of using the public space as a short cut from St. Paul's or Newsgate Street to Cheapside, once the pedestrians manage to negotiate their route through the set of traffic lights, they prefer to carry on walking following the outside pavement instead of walking through the public space.

Around New Change/Cheapside Corner, the mean number of moving people (streets only) is 1084.80 compared to 56.00 pph crossing the public space.

5.1.2.9. North Guildhall

The characteristics of pedestrian movement in this area are the same as those described previously for Love Lane Corner. However, compared to Love Lane Corner, the levels of pedestrian movement inside North Guildhall are very high, similar to Fenchurch Place. Movement is very intense and is mainly restricted to two different routes: from the Barbican via the footbridge diverting to either Aldermanbury or Basinghall Street. The other main pedestrian route is the one that links Aldermanbury or Basinghall (Fig. 9, Plate 5.2). The mean number of moving people recorded in the surrounding area is 404 pph, while inside the public space is 324.00 pph.

5.1.2.10. Royal Exchange

The level of pedestrian movement is high, although it is restricted to the route between Threadneedle Street and Cornhill, where a mean of 1032 pph was observed. The pedestrians effectively use Royal Exchange as a "short cut" between the south side of Bank area and the north side of the City. Conversely, the level of pedestrian movement from Royal Exchange Av. towards Threadneedle Street is low, where a mean of only 62 pph was recorded (Fig. 10, Plate 5.2). This gives a mean of 547 pph for the public space as a whole. Pedestrian movement is very intense in the major adjacent thoroughfares, where 1183.25 pph were recorded.

5.1.2.11. St. Anne & St. Agnes churchyard

Pedestrian movement in the area is not intense compared to other areas of the City. The highest pedestrian movement rate in the area was 1340 pph, recorded in St. Martins Le Grand. Nevertheless, the ratio of pedestrian movement drops substantially for the other surrounding streets. In Gresham Street, a mean of 540 pph was recorded and 225 pph was observed in Noble Street (Fig. 11, Plate 5.2). In addition, pedestrian movement inside the public space is extremely low, where 4, 14, and 16 pph were observed in different locations. This gives us a mean of 362.00 pph for the surrounding streets. The mean of moving people inside the public space is 11.33 pph, the lowest rate of all cases.

5.1.2.12. Whittington Gardens

Pedestrian movement in the area is of medium intensity. In Upper Thames Street, despite it being a very important thoroughfare in the City, the level of pedestrian movement is low compared to the amount of vehicular movement. Upper Thames Street is a wide dual carriageway road that is an important vehicular traffic route in the area, but is disconnected from local roads. The high number of footbridges and flyovers connecting streets at both north and south sides illustrates this. The mean number of moving people recorded in Upper Thames Street was 810 pph, which is not particularly high, compared to Cannon Street with 1960 pph (Fig. 12, Plate 5.2). In fact, this number is particularly affected by the location of the gate in relation to the pedestrian traffic light. Once we move east the level of pedestrian movement along Upper Thames Street drops substantially. Conversely, there is a high pedestrian movement rate from Southwark Bridge towards Cannon Street. After crossing Upper Thames Street, pedestrians walk alongside the public space and most of them take Little College Lane towards Cannon Street (refer to Plate 4.12, Appendix 2). Nevertheless, the number of people crossing the public space is relatively high with 108.00 pph. The mean number of moving people around the area is 793 pph.

5.1.3. RE-ASSESSING THE AXIAL BREAK-UP MODEL

Before proceeding with the analysis of levels of pedestrian movement, it is imperative to ensure that the representation of the configurational properties of the City of London, in particular the permeability and visibility links of public spaces, is adequate. In Chapter 4, for the analysis of public spaces, the effective space representation was adopted, but no previous knowledge of public space internal layout was considered. It was this representation that was used when connecting convex spaces and axial lines; that is, a convex break up by function. Some questions are raised by the attempt to a suitable model for the configurational properties of public spaces and the urban fabric in which they are embedded. The previous axial model (effective space model) was made by taking the fewest and longest lines of permeability and visibility that covered all the convex spaces in the urban environment in order to be compatible with the model used for the morphological analysis of traditional urban European squares. However, the model has already given some indications that it was not fully representative of the actual system of pedestrian routes and therefore could possibly underestimate the extent of the interface between the public space and the large scale structure of the urban fabric.

There is some evidence to suggest that, if a purely theoretical and formal approach is taken to axial line representation, some lines have been observed to over perform in terms of the movement that they are observed to carry for their degree of spatial integration. Stonor (1992) has suggested this regarding Broadway in Manhattan. More pertinent for this thesis, it has already been suggested for the particular case of Finsbury Av.

> "Another case of an over performing diagonal is in the south-east to north-west line linking Broadgate Circle to Finsbury Avenue Square in Broadgate. Once again, the true modelling of the line, underestimates the observed movement, but remodelling as a single diagonal yields a good approximation of the observed rates. Again, the interface would seem to be that Londoners read this diagonal as straighter than it is."
>
> (Hillier, 1997, p3)

These observations lend weight to the suggestion that adding empirically observed pedestrian routes to fine-tune the pure, minimal, spatial axial model may improve its ability to model not just the observed levels of pedestrian movement but its distribution[12].

The proposed model for this chapter is a development of the previous effective space model used in the morphological analysis of the City's spaces in Chapter 4. However, in this case, the observed effective routes of pedestrian movement across the public space are added, whenever these are seen to differ from the theoretical model of axial routes that was employed earlier. Abchurchyard is properly modelled with only one axial line since there is not any other major route that could be taken through the public space in the context of the surrounding routes, as seen in Figure 5.2a (a thick black line represents the axial line that interfaces with the public space). However, in the case of Finsbury Av. (Fig. 5.2b) or Fleet Place (Fig. 5.2c), although the previous model connected the convex spaces, there is one route in each case, represented by a dotted line, that is obviously missing when the public space is observed for patterns of pedestrian movement. It is clear that these routes should be added to the axial representation in order to give a full account of pedestrian movement in the area.

---

[12] To adjust the axial break-up map according to empirical observations is a standard part of the research as pointed out by Hillier (1999). "Part of the researcher's task is to discover which representation and which measure captures the logic of a particular system, as shown by observation of its functioning" (Hillier, op.cit., 169).

The "effective routes model" (Fig. 5.2), as it will be referred to, adds an extra layer to the previous model, which includes the axial lines that cover all effective pedestrian routes. As long as there were permeability and visibility connections, the axial lines were prolonged to intercept the axial lines to the surrounding urban grid, but using the fewest and longest axial lines that would cover all the connections established from the convex model.

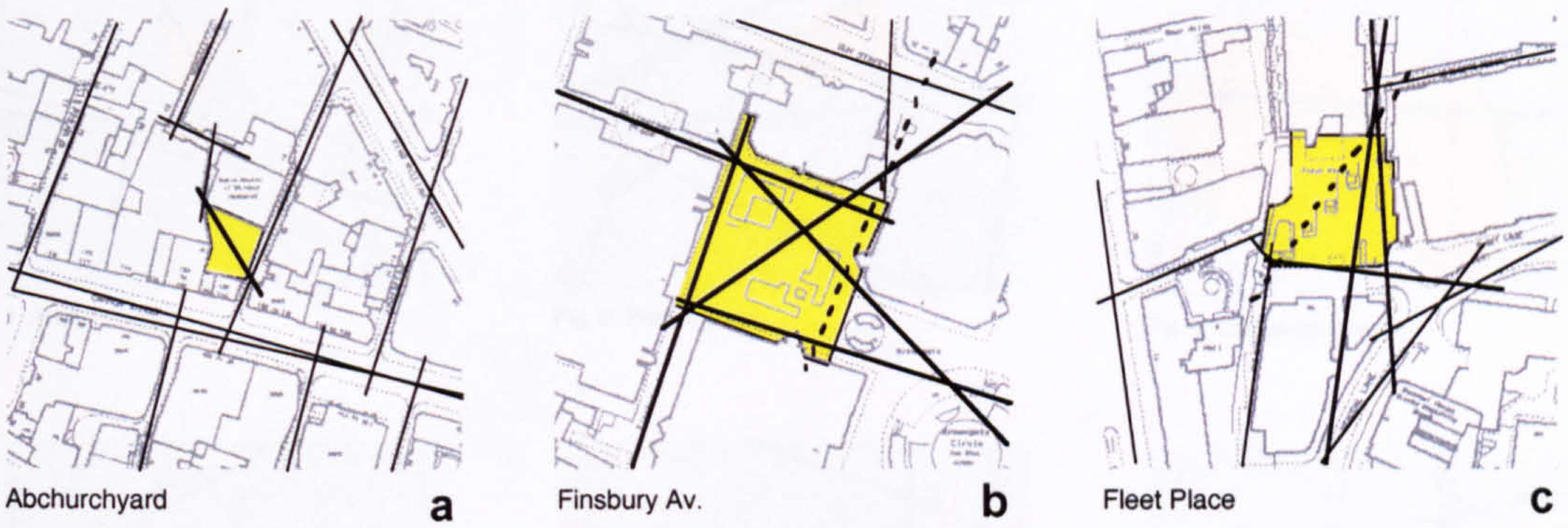

Figure 5.2. Effective routes axial model

Plate 5.3 (next page) illustrates the final model for the selected public spaces (indicating the axial lines according to the C, T, P classification), named the "effective routes model". This model will be tested in the second part of this chapter, for its suitability for the quantification of static people inside public spaces.

5.1.4. THE CITY OF LONDON SYNTACTIC ANALYSIS

It is not possible to fully evaluate patterns of spatial use of public spaces without first understanding the principles of the existing working grid in which they are embedded. Therefore, the investigation started with a syntactic analysis of the City of London using the effective routes axial model (refer to Figure 1, Plate 5.4, page after next)[13]. For this research, it is important to study the degree of intelligibility of the City of London for two main reasons. Firstly, as discussed in Chapter 2 (Section 2.4.2), the more intelligible the area, the more accurate the prediction of pedestrian movement is likely to be. Also, if intelligibility expresses the degree that the large scale structure of the urban grid can be understood from its local parts, intelligibility is an important concept for assessing the impact of public spaces in the global context.

[13] The axial break-up map in question does not cover the whole of London, it refers to the 4.5 km radius area around the City of London as illustrated in Figure 4.4, Chapter 4, with a total of 5693 axial lines.

Plate 5.3. City of London public spaces showing axial lines according to classification

scale: 1:3500

public space

convergent axial lines

transverse axial lines

remaining axial lines

peripheric axial lines

Fig. 1. Abchurchyard

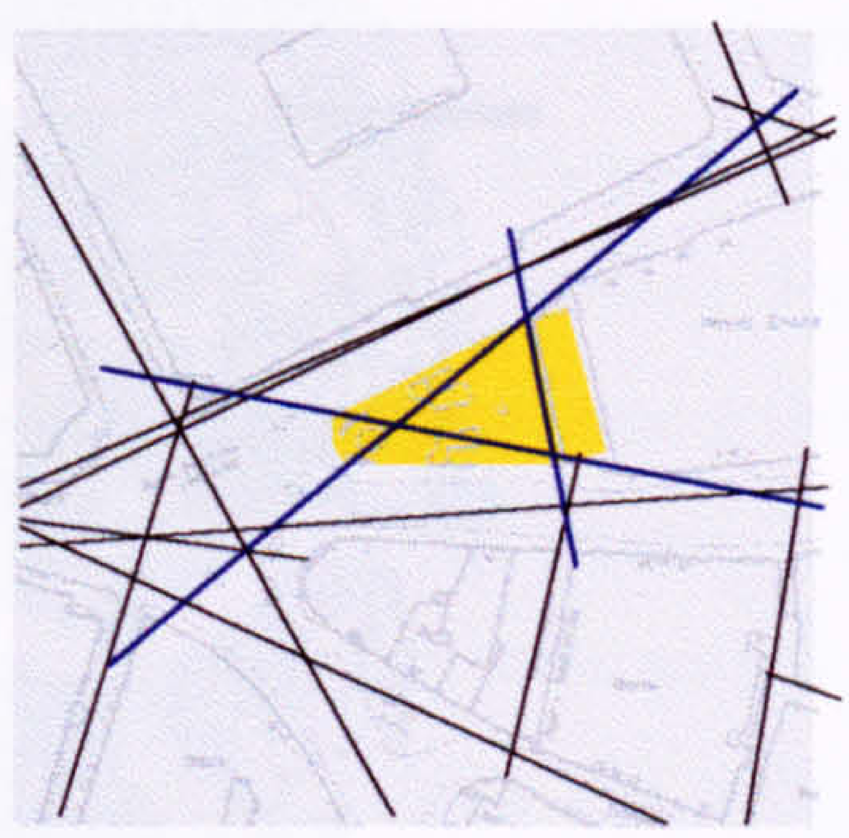

Fig. 2. Bank Corner

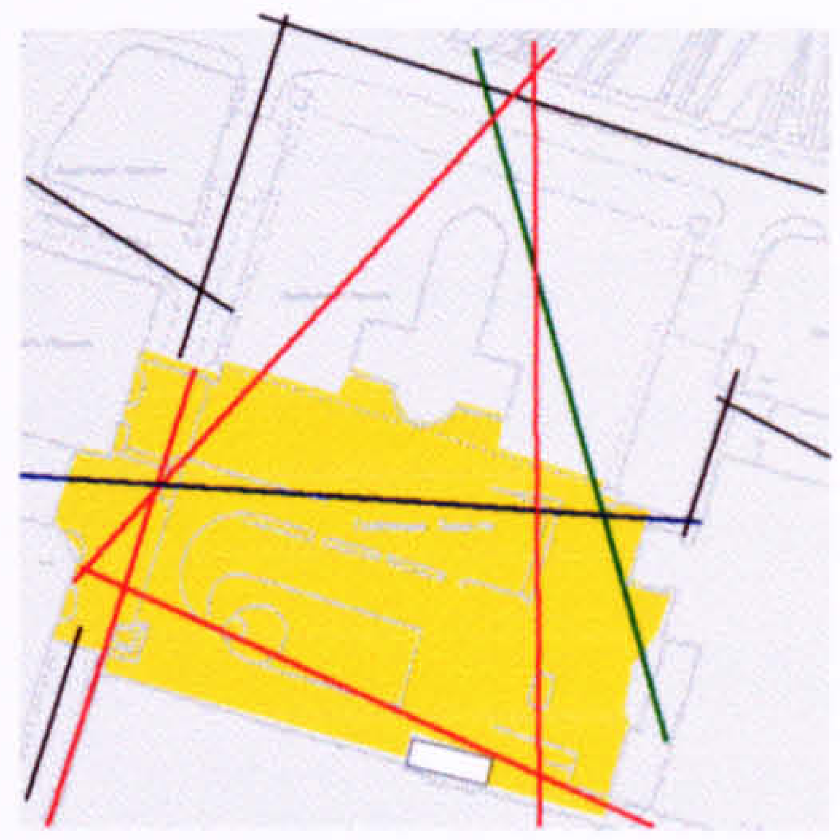

Fig. 3. Exchange Square

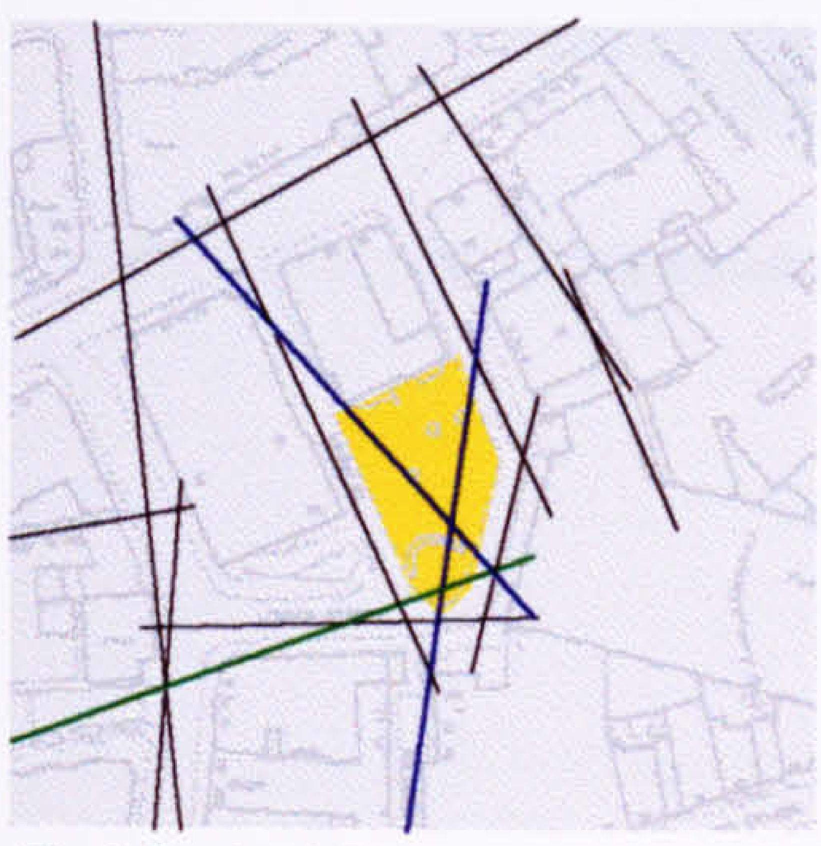

Fig. 4. Fenchurch Place

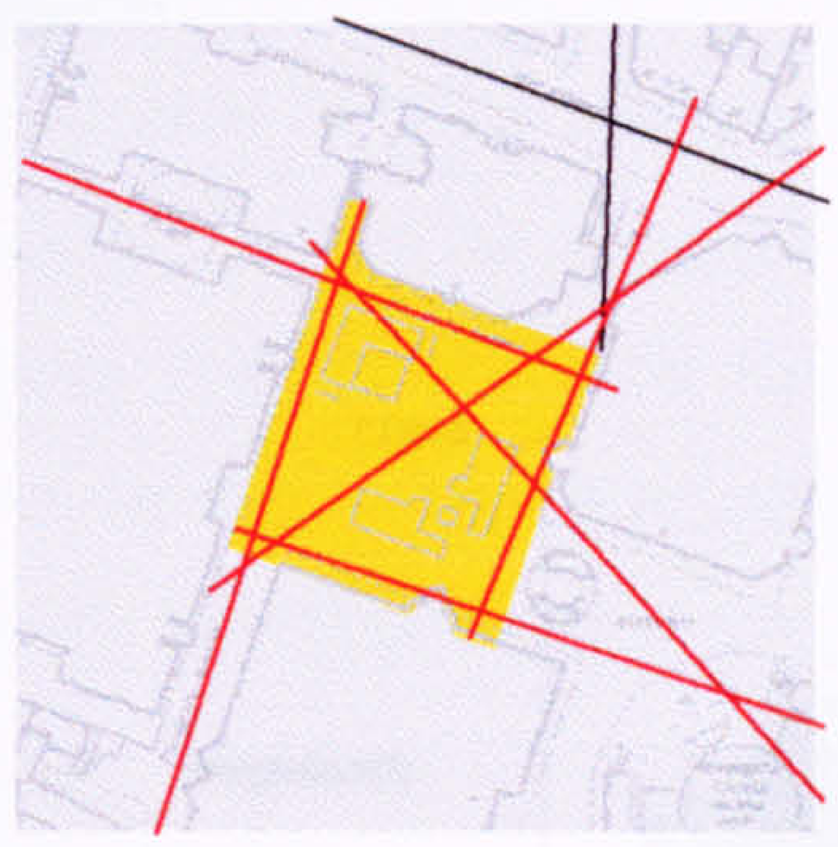

Fig. 5. Finsbury Av.

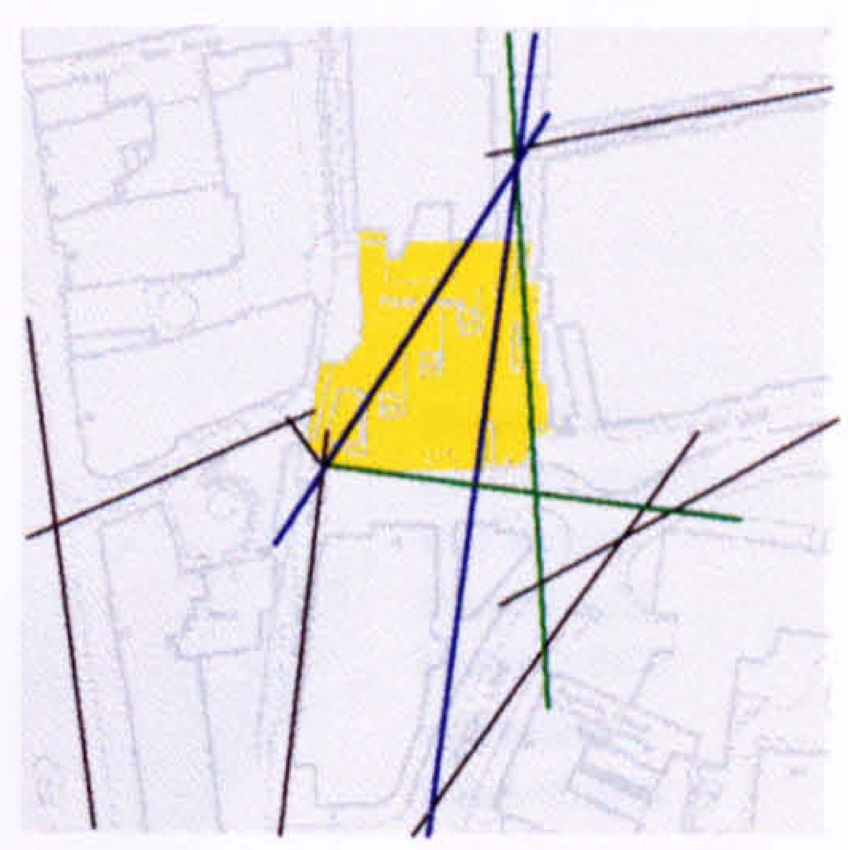

Fig. 6. Fleet Place

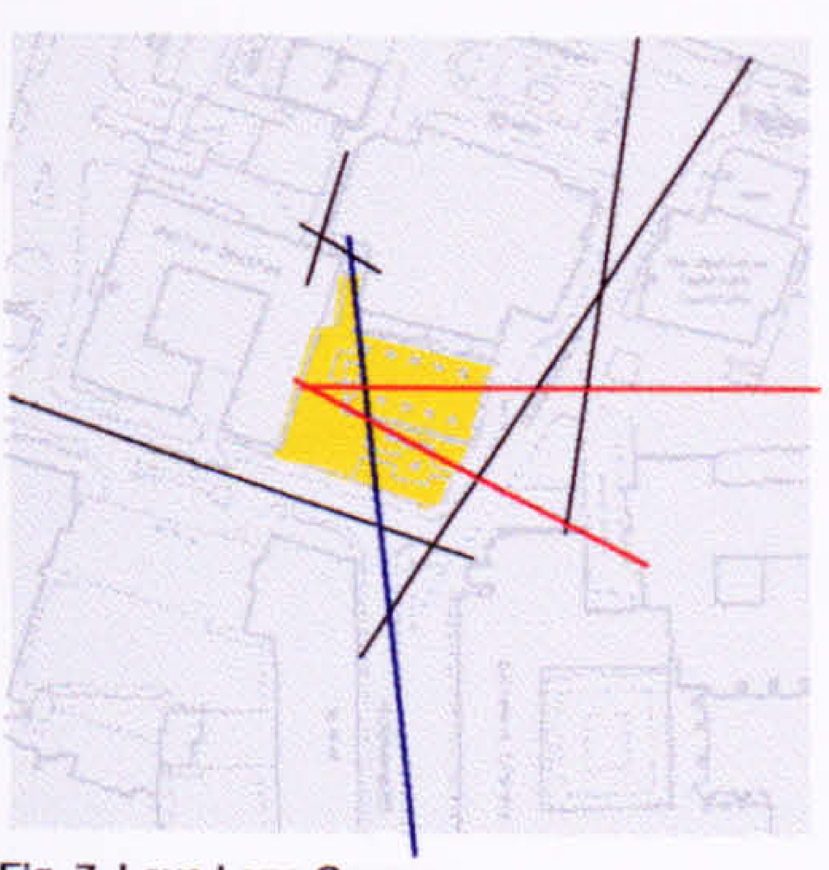

Fig. 7. Love Lane Corner

Fig. 8. New Change/Cheapside Corner

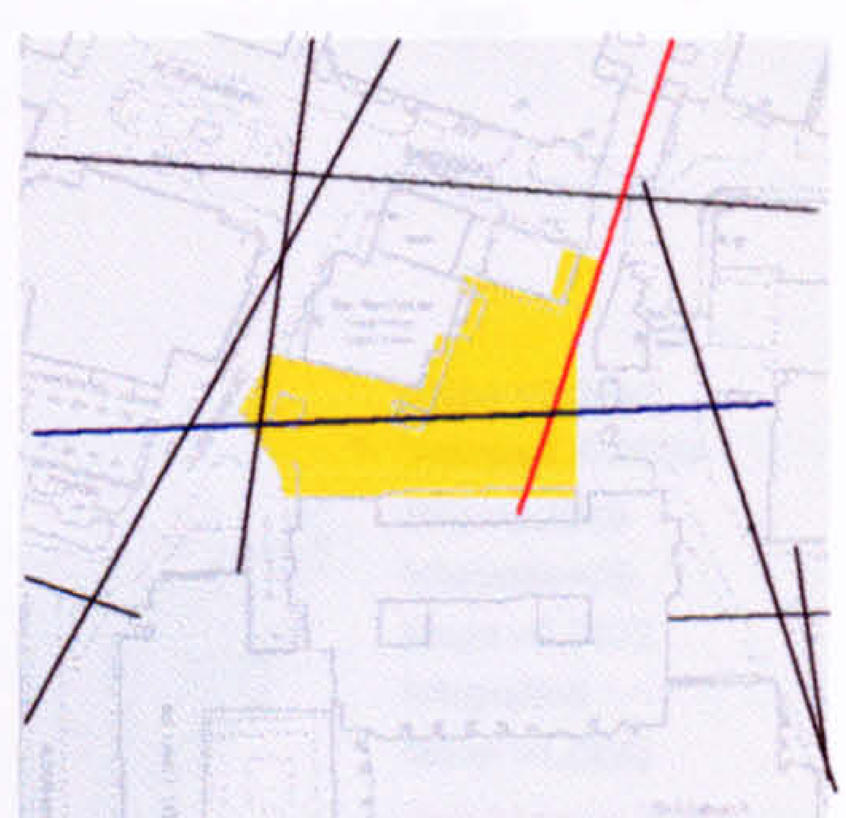

Fig. 9. North Guildhall

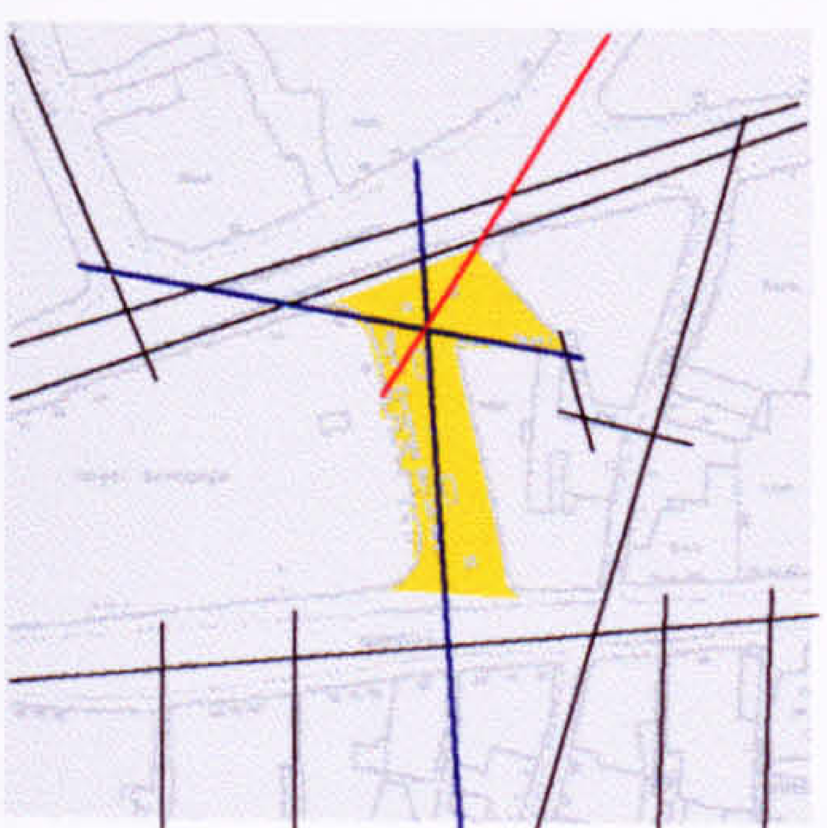

Fig. 10. Royal Exchange

Fig. 11. St. Anne St. Agnes churchyard

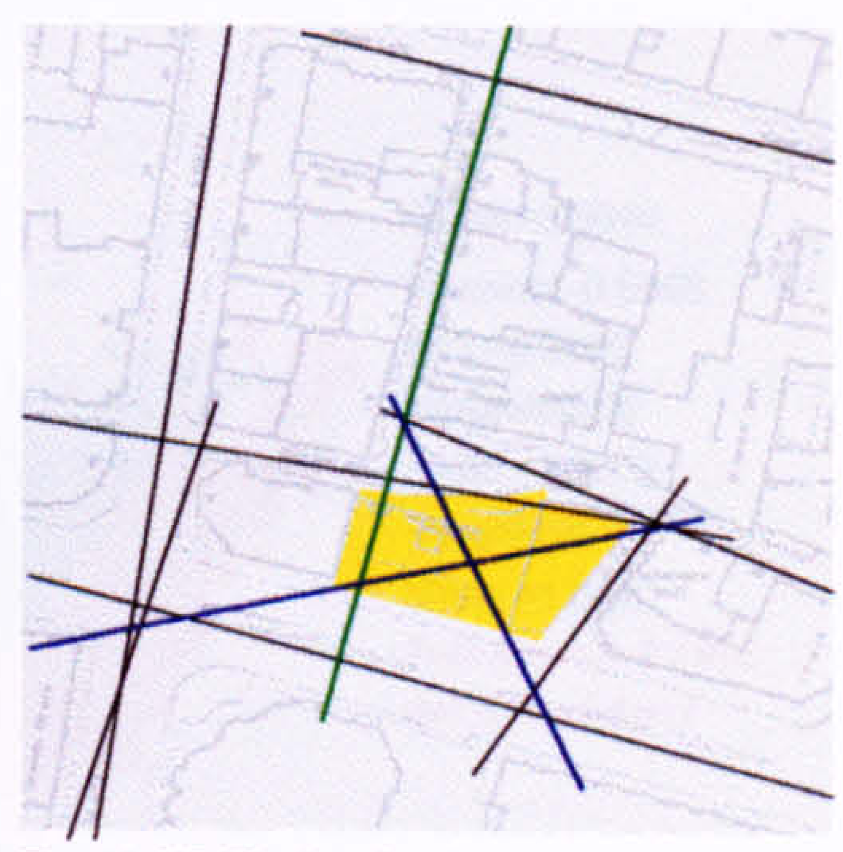

Fig. 12. Whittington Gardens

Plate 5.4. Axial break-up model of London and sub-areas

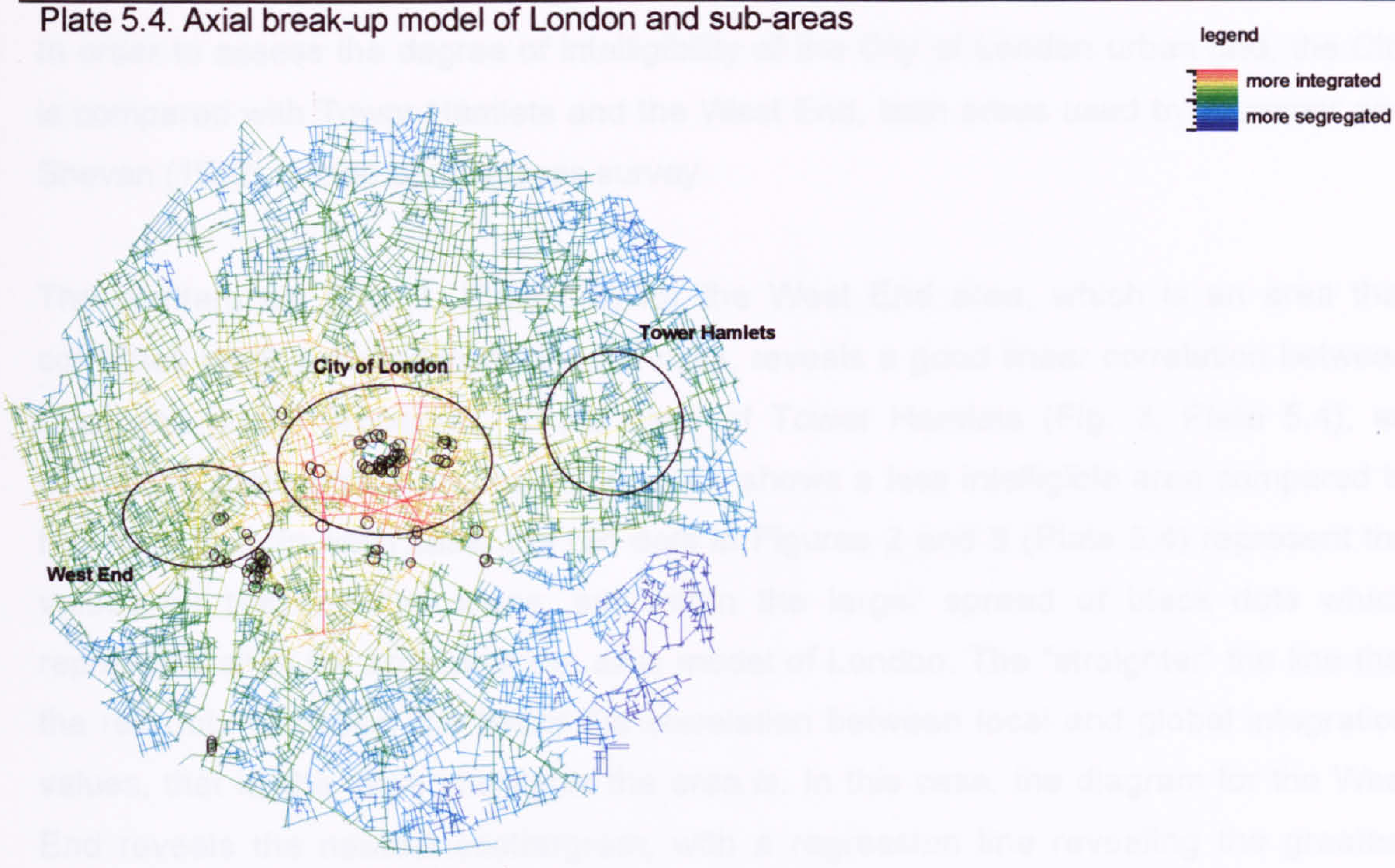

Fig. 1. Global integartion model highlighting sub areas

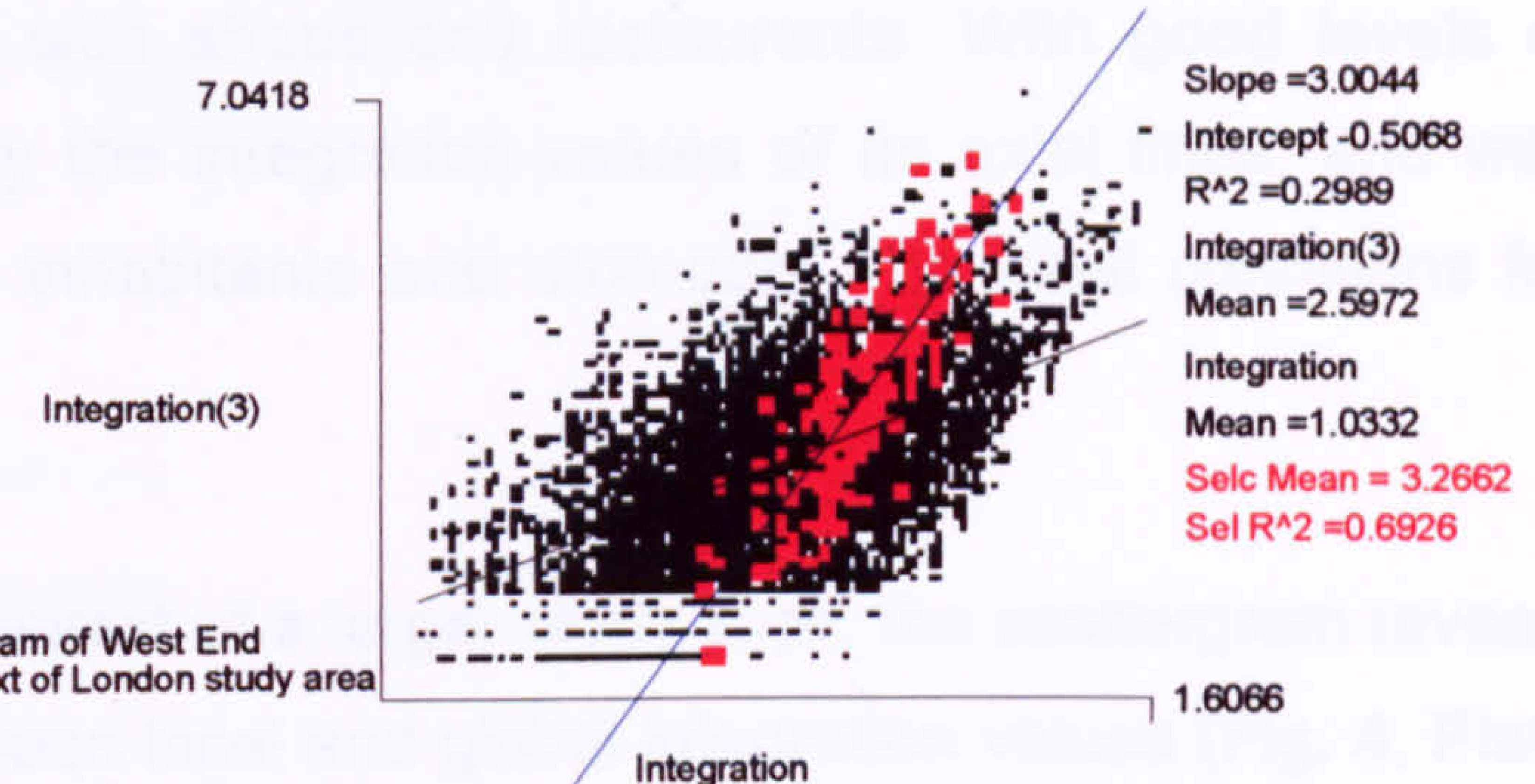

Fig. 2. Scattergram of West End within the context of London study area

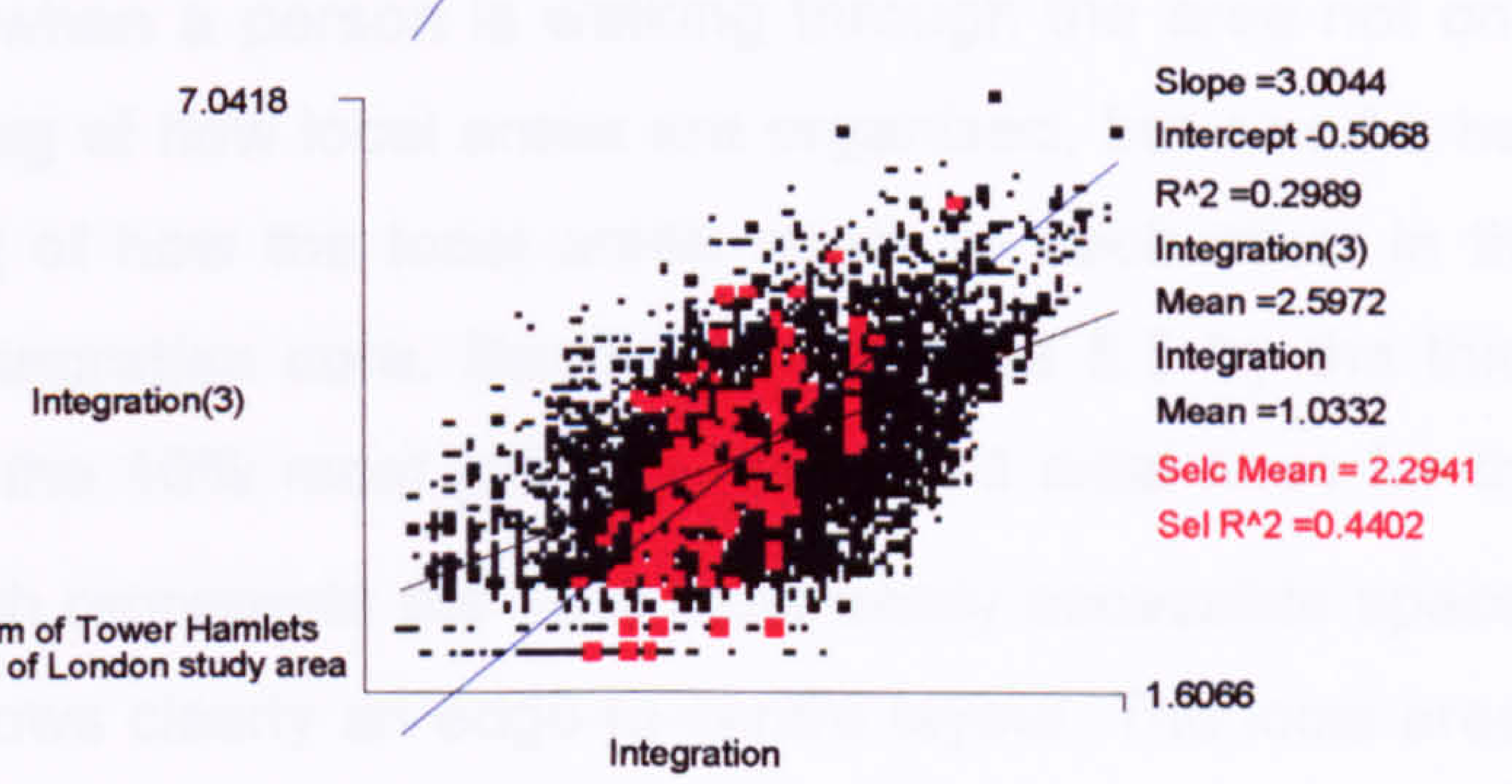

Fig. 3. Scattergram of Tower Hamlets within the context of London study area

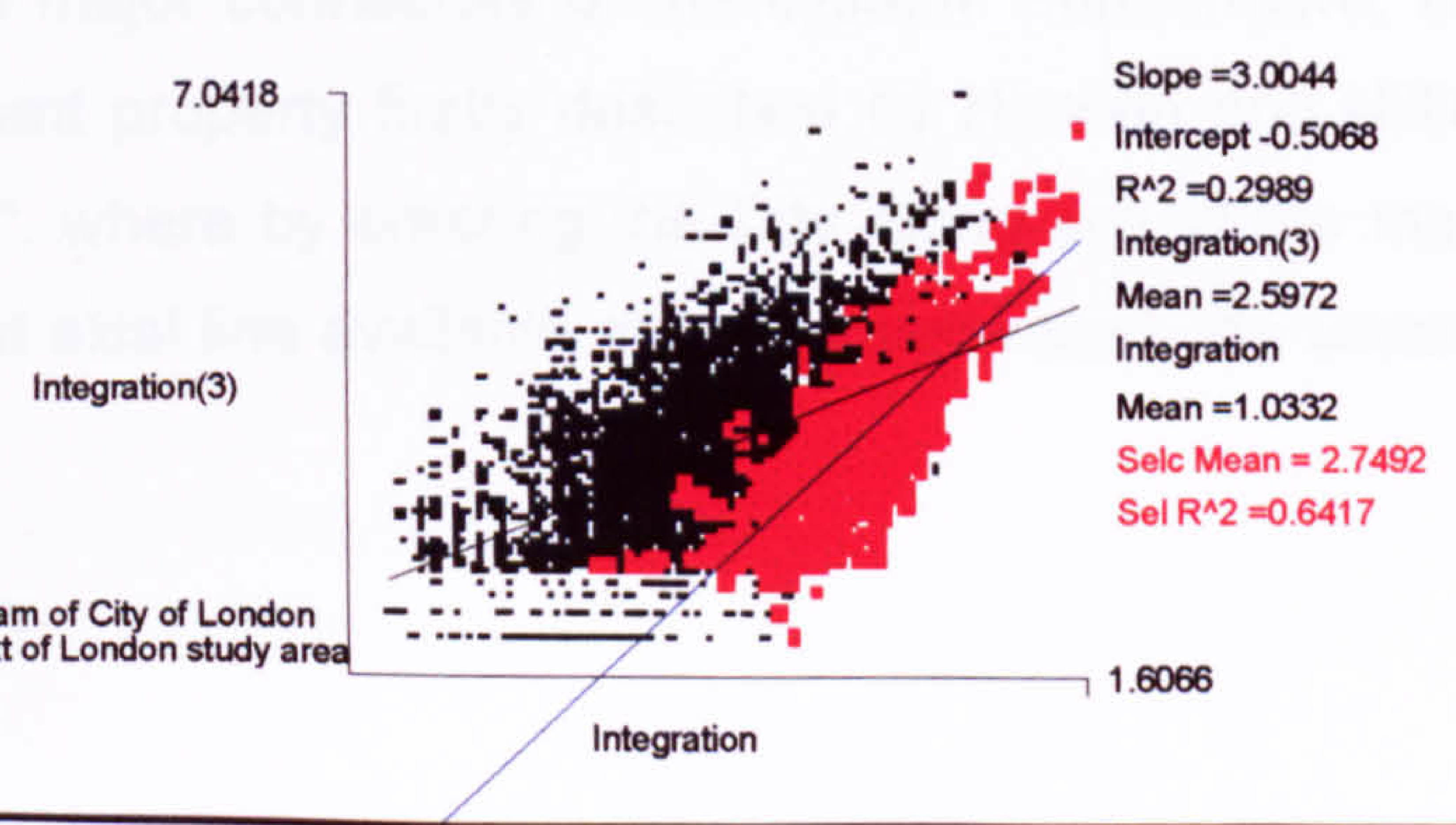

Fig. 4. Scattergram of City of London within the context of London study area

In order to assess the degree of intelligibility of the City of London urban grid, the City is compared with Tower Hamlets and the West End, both areas used by Plummer and Shevan (1992) in their open spaces survey.

The scattergram (Fig. 2, Plate 5.4) for the West End area, which is an area that combines retail, entertainment and services, reveals a good linear correlation between local and global properties. In the case of Tower Hamlets (Fig. 3, Plate 5.4), an essentially residential area, the scattergram shows a less intelligible area compared to the West End. In each case, the red dots in Figures 2 and 3 (Plate 5.4) represent the values for the selected areas, set within the larger spread of black dots which represents all of the spaces in the axial model of London. The "straighter" the line that the red dots compose, the better the correlation between local and global integration values, that is, the more intelligible the area is. In this case, the diagram for the West End reveals the neatest scattergram, with a regression line revealing the greatest steepness of the two. Probably, it is not by chance that the West End is such a dynamic area, heavily populated with shops and restaurants. With good levels of pedestrian movement indicated by the integration values of its axial lines, and with relatively good interface between inhabitants and strangers, the ideal conditions for trade were created and supported.

When the City is analysed in the context of a larger study area, the scattergram reveals a very good linear correlation between local and global integration values (Fig. 4, Plate 5.4), indicating that, as in the West End, there is also a good degree of intelligibility. Therefore, in the City of London, when a person is walking through the area not only does he have a good understanding of how local areas are organised, but also he has an additional good understanding of how the local areas relate to each other in the global context. In addition, the integration core, illustrated in Figure 5.3 by the thick black lines (in this case showing the 10% most globally integrated axial lines for the City of London[14] on its own), which represents the 10% most easily accessible spaces in the urban layout as a whole, shows clearly an edge-to-centre layout. The local areas are immediately accessible to the major connectors of the system. Furthermore, the axial map reveals another important property firstly described by Hanson and Hillier (1992) named the "two step logic", where by entering the City along any of the main traffic routes and taking the longest axial line available at each intersection, the second

[14] According to the administrative boundary.

line that one passes along leads to an intersection from which it is possible to see the centre of the City at Bank Corner.

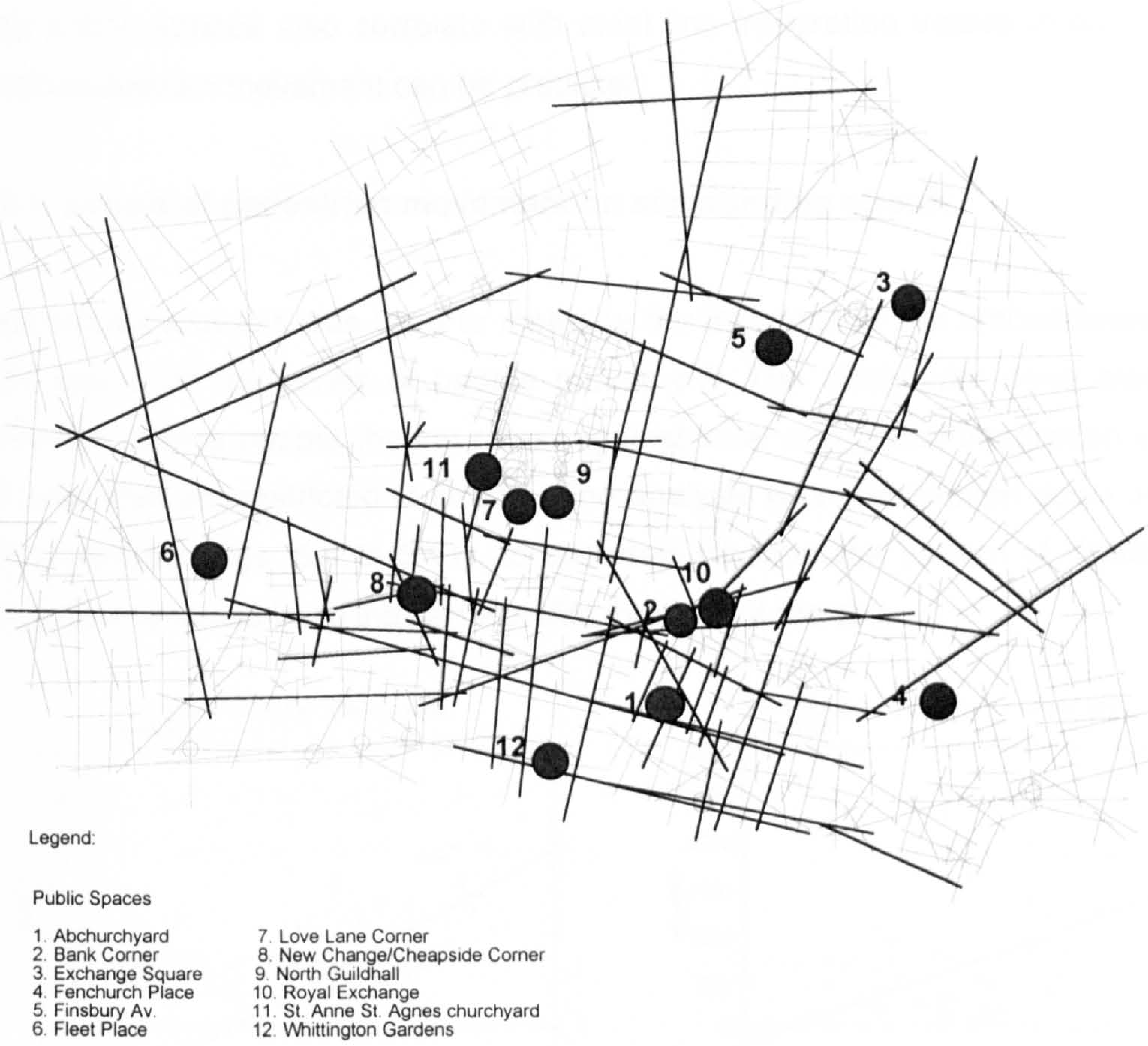

Figure 5.3. Partial axial break-up of the City of London showing the location of the selected public spaces and the 10% integration core

All these properties (illustrating the articulation of local areas to the major grid structure) make the City of London very accessible not only for the people who are accustomed to the area but also to those who are not familiar with it. Hanson (1980) has already pointed out that intelligibility leads to a stronger movement interface between inhabitants and strangers. In doing so, it is likely that the grid structure of the City of London enhances the "mechanisms for generating a potential field of probabilistic and co-presence" (Hillier et al., 1978a, p248) with respect to positive levels and patterns of public space use.

5.1.5. PEDESTRIAN MOVEMENT DATA ANALYSIS

This section examines the relationship between levels of pedestrian movement and syntactic measures. The analysis is divided into two stages. Firstly, based on the theory of natural movement (Hillier et al., 1993a), it is assessed whether the levels of pedestrian movement in the surrounding areas of public spaces correlate with axial line integration values. Secondly, it is assessed whether levels of pedestrian movement inside public spaces also correlate with axial line integration values in so far as the level of pedestrian movement can be predicted.

5.1.5.1. Levels of pedestrian movement on surrounding streets

Space syntax analysis was used to measure the influence of the embeddeness of the public space on the levels of people movement. The study was done plotting the number of moving people (hourly rates) against local and global integration values of axial lines that are restricted to streets. The analysis was also broken down according to time periods (Figs. 5.4 to 5.11), to ascertain whether the pattern of distribution of moving people would keep the same profile throughout the day.

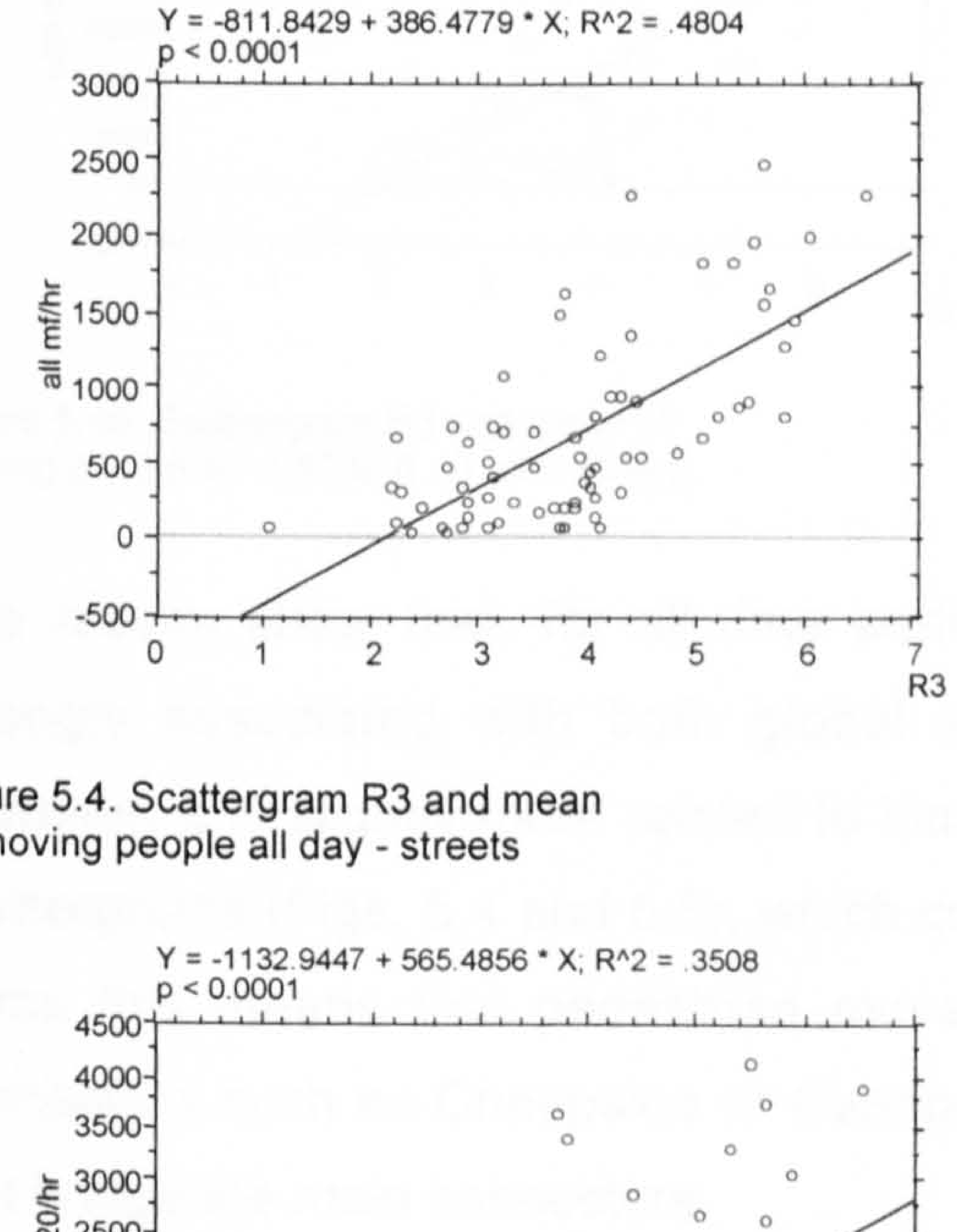

Figure 5.4. Scattergram R3 and mean nº moving people all day - streets

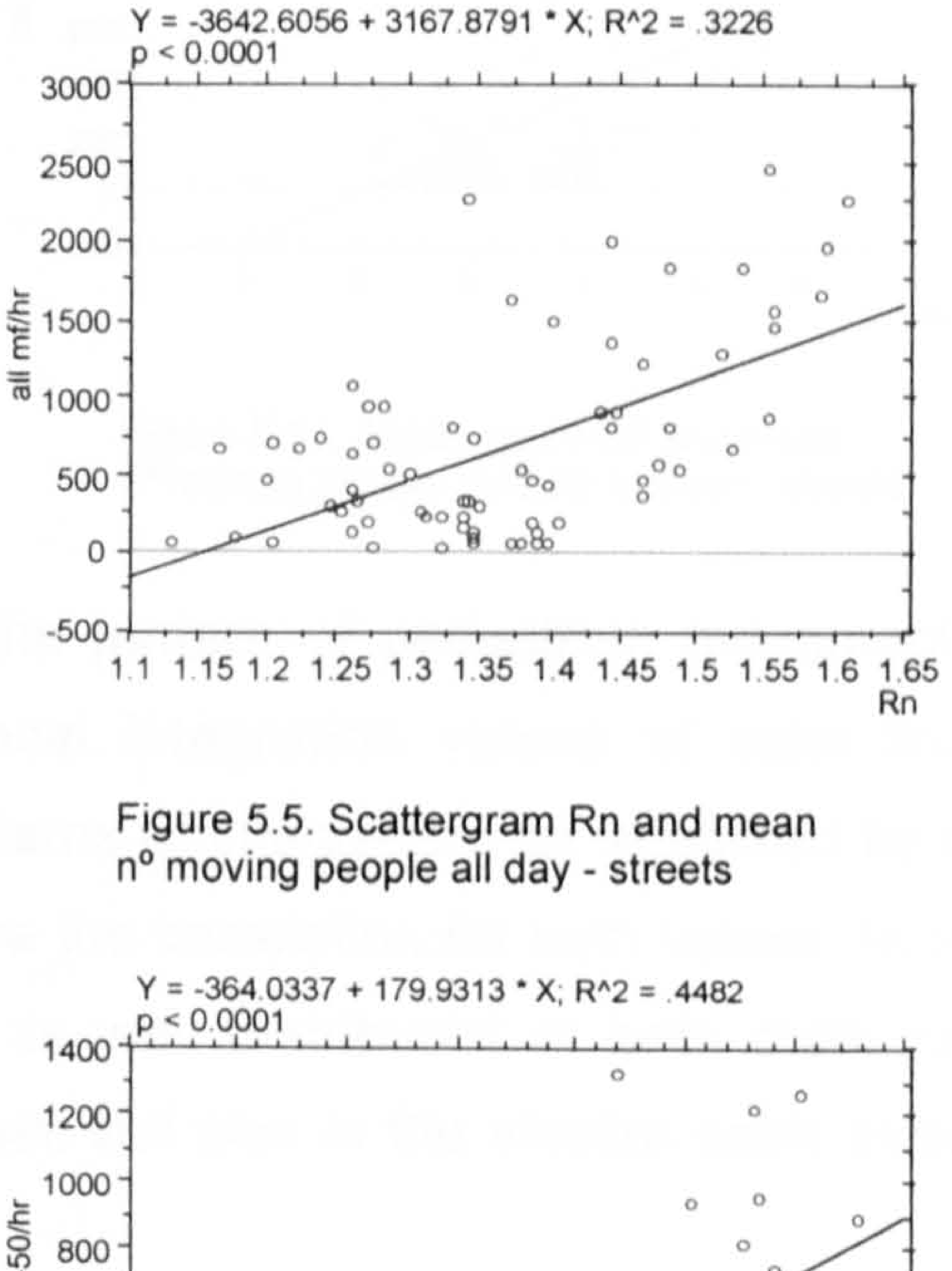

Figure 5.5. Scattergram Rn and mean nº moving people all day - streets

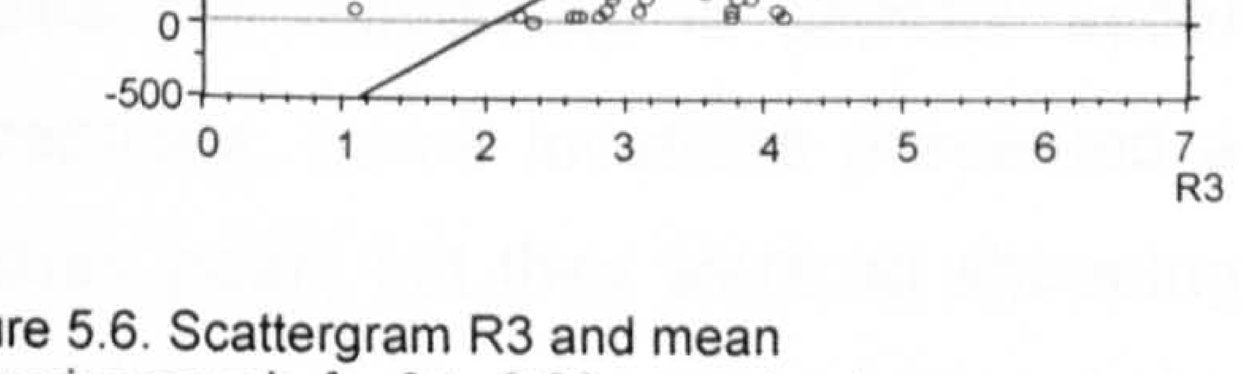

Figure 5.6. Scattergram R3 and mean nº moving people for 8 to 9.20 am - streets

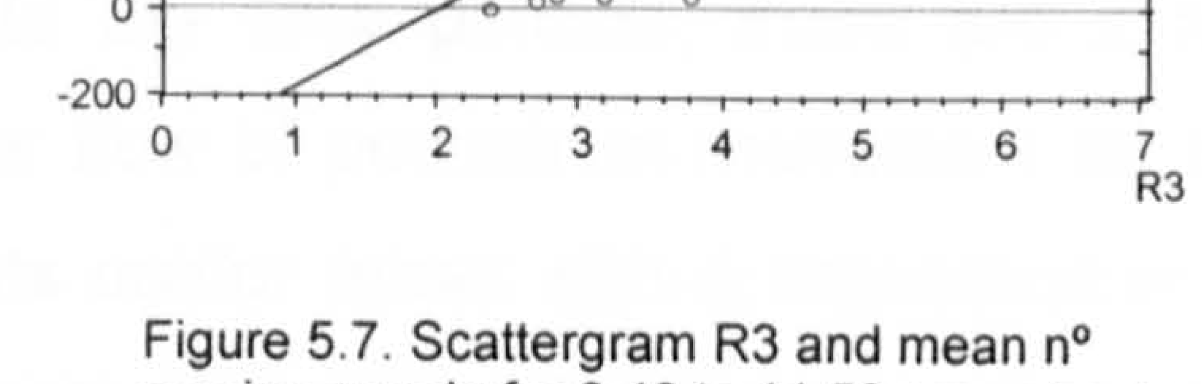

Figure 5.7. Scattergram R3 and mean nº moving people for 9.40 to 11.50 am - streets

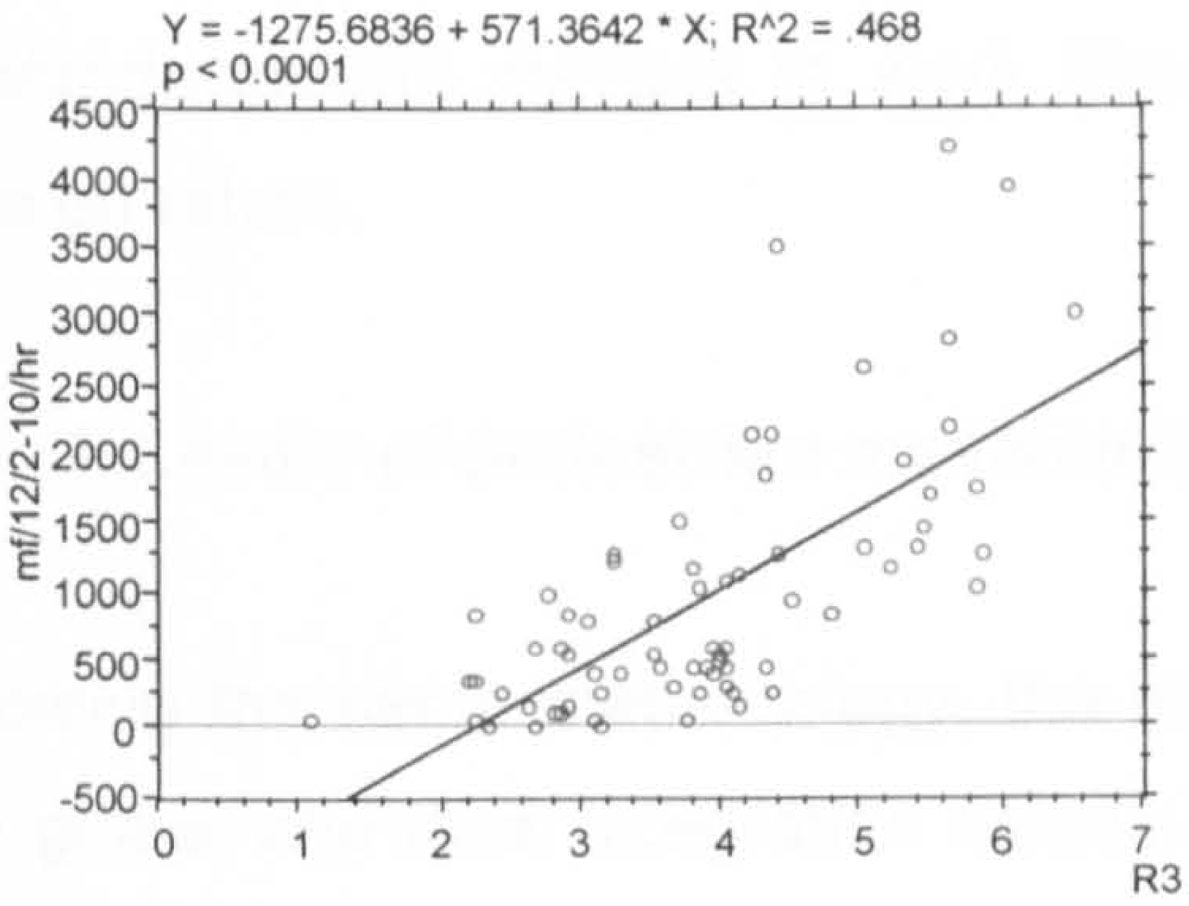

Figure 5.8. Scattergram R3 and mean n° moving people for 12 to 2.10 pm - streets

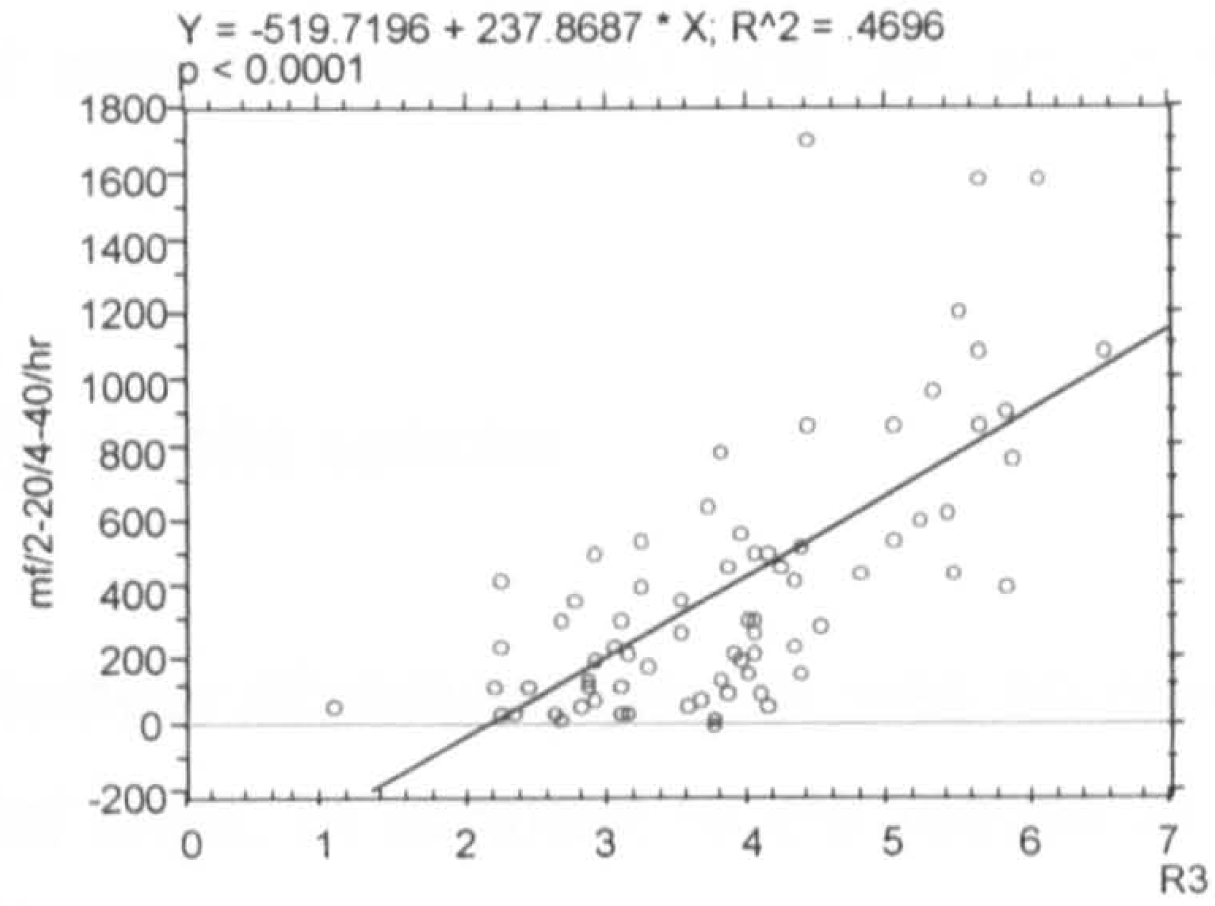

Figure 5.9. Scattergram R3 and mean n° moving people for 2.20 to 4.40 pm - streets

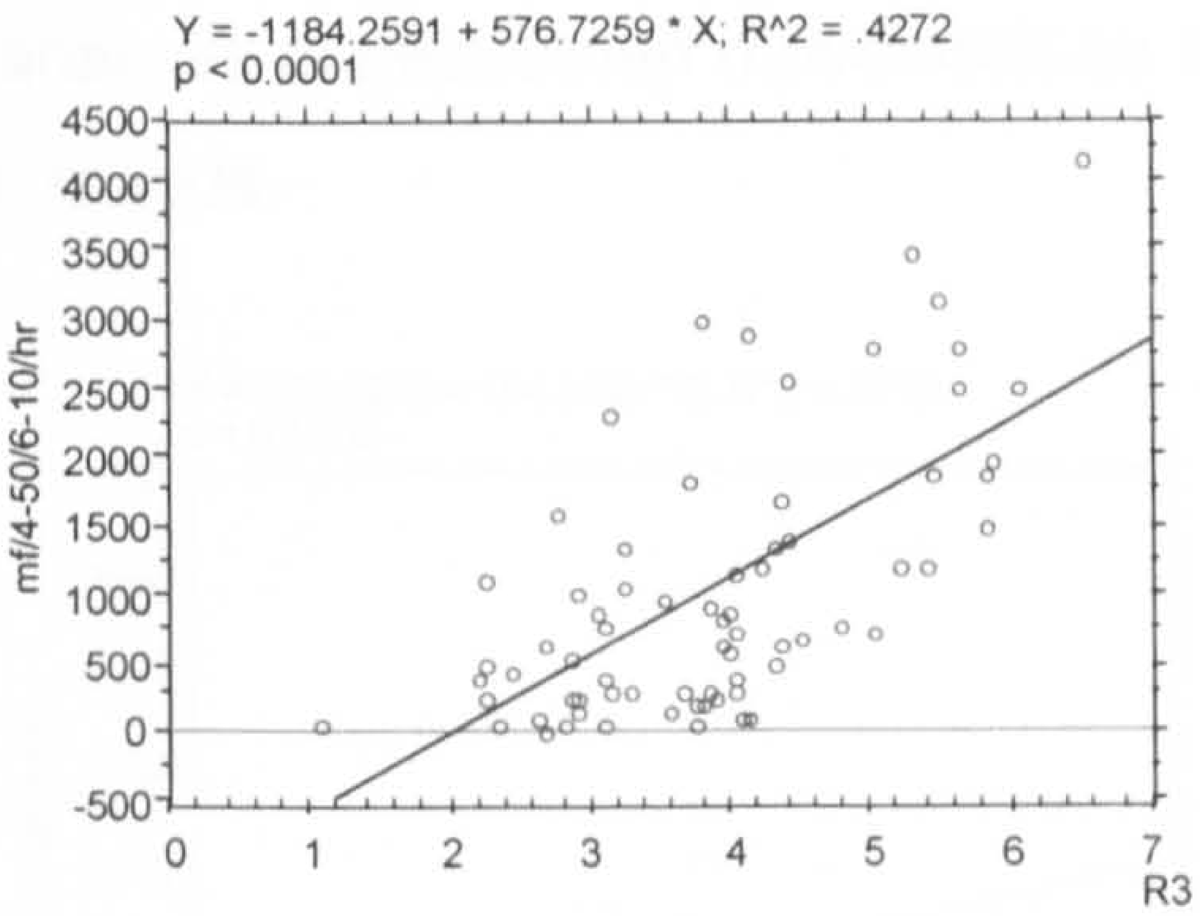

Figure 5.10. Scattergram R3 and mean n° moving people for 4.50 to 6.10 pm - streets

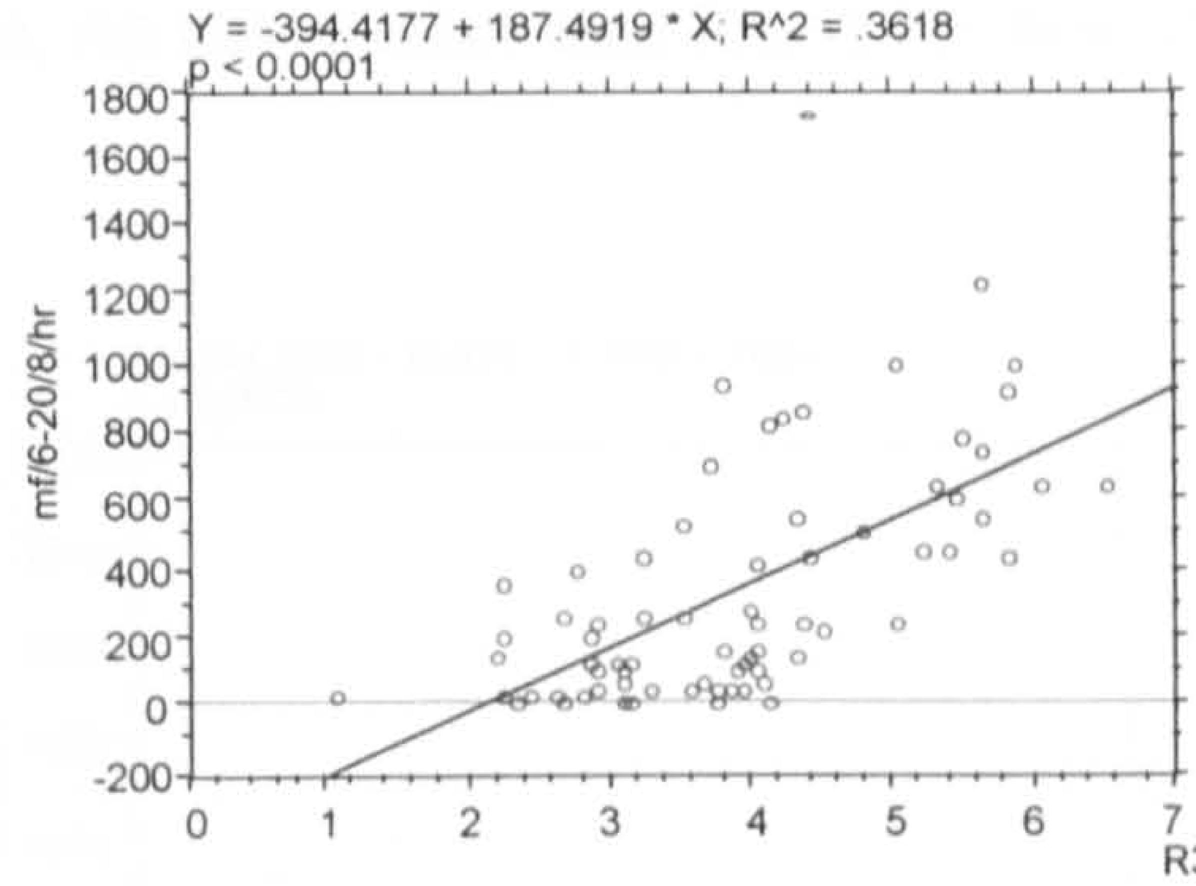

Figure 5.11. Scattergram R3 and mean n° moving people for 6.20 to 8 pm - streets

The results show that, for all time periods, the pattern of pedestrian movement is strongly associated with both global and local integration values of axial lines. However, it is slightly more related to local patterns of integration, as illustrated by the scattergrams (Figs. 5.4 and 5.5), which compare the correlation for both values. In real terms this means that pedestrian movement is well distributed in both main road connectors such as Cheapside or Cannon Street, but also in the smaller scale streets that bridge the main connectors.

In addition, inspection of the data also suggests that, although the distribution of pedestrian movement is uniform according to the time periods, there are a few exceptions. Some locations presented a higher flow of pedestrian movement for the midday peak, but they were all shopping streets and/or areas with a concentration of sandwich shops, newsagents or local shops. There were also a few locations that were intensely used in the peak morning period and much less at the afternoon peak[15]

[15] A typical case is the level of pedestrian movement recorded for gates 4.4 and 4.10 (refer to Plate 5.1 in Appendix 3) for Fenchurch Place.

suggesting that, in some areas, pedestrian movement can follow a certain route from train/underground stations to work (the most common example) and an alternative route on return.

5.1.5.2. Levels of pedestrian movement inside public spaces

Following the same methodology, the mean number of moving people was correlated with global and local integration values of axial lines. In contrast to the results of the last section, no relationship was found for both local and global values, seen in Figures 5.12 and 5.13. The analysis was subsequently broken down into time periods. Showing only scattergrams for local integration values (Figs. 5.14 and 5.19) for comparison with the analysis of pedestrian movement on streets, no correlation was found for any of the time periods.

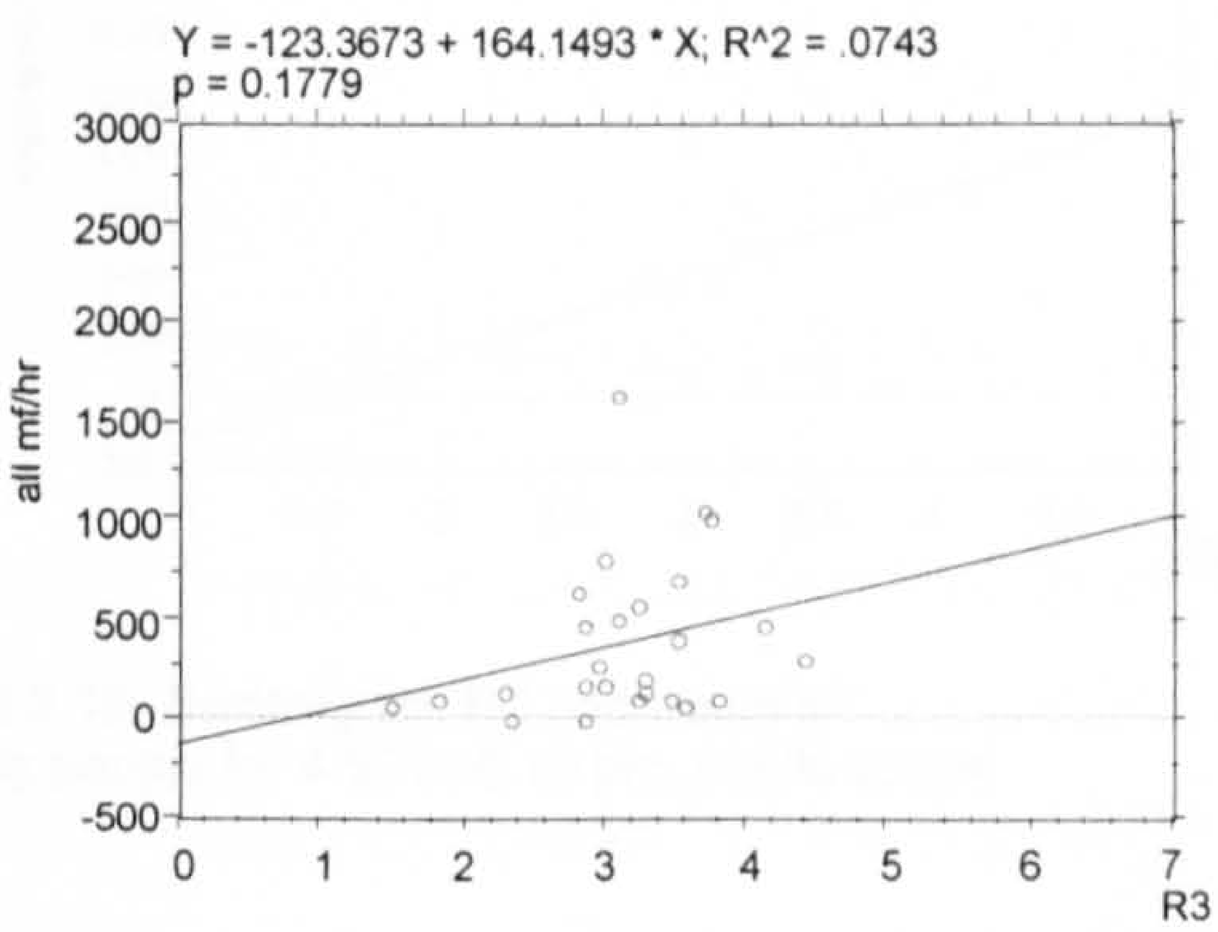

Figure 5.12. Scattergram R3 and mean n° moving people all day, public space

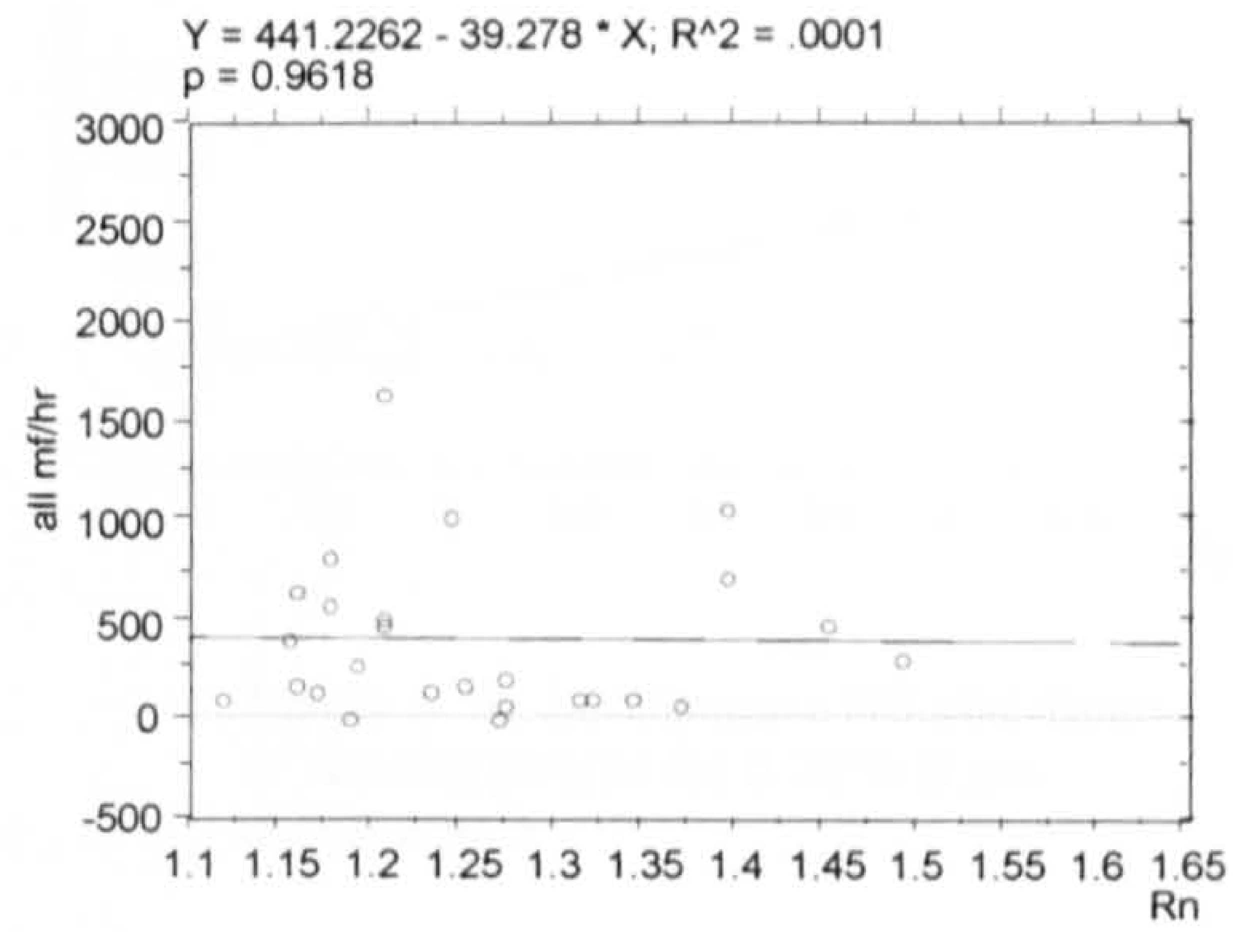

Figure 5.13. Scattergram Rn and mean n° moving people all day, public space

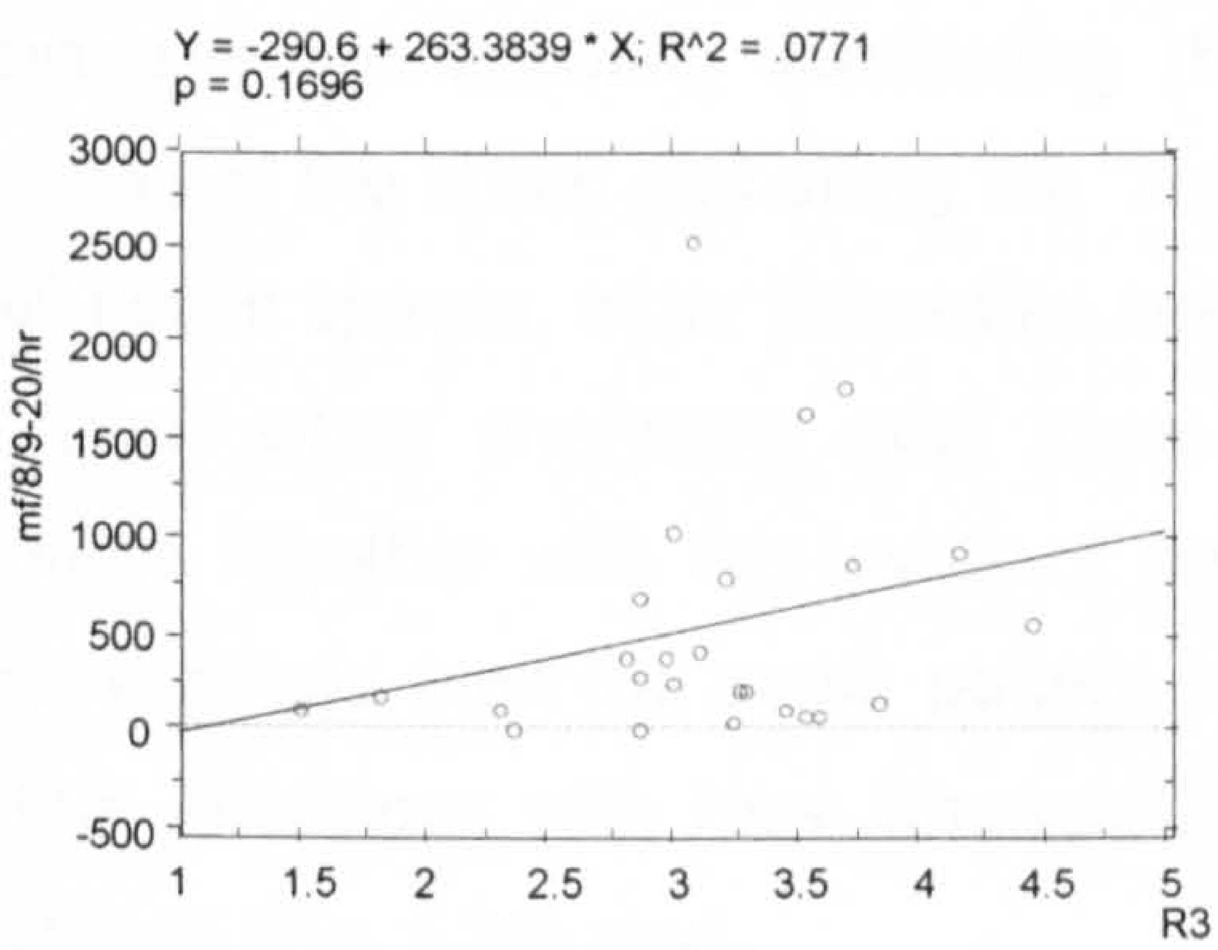

Figure 5.14. Scattergram R3 and mean n° moving people for 8 to 9.20 am, public space

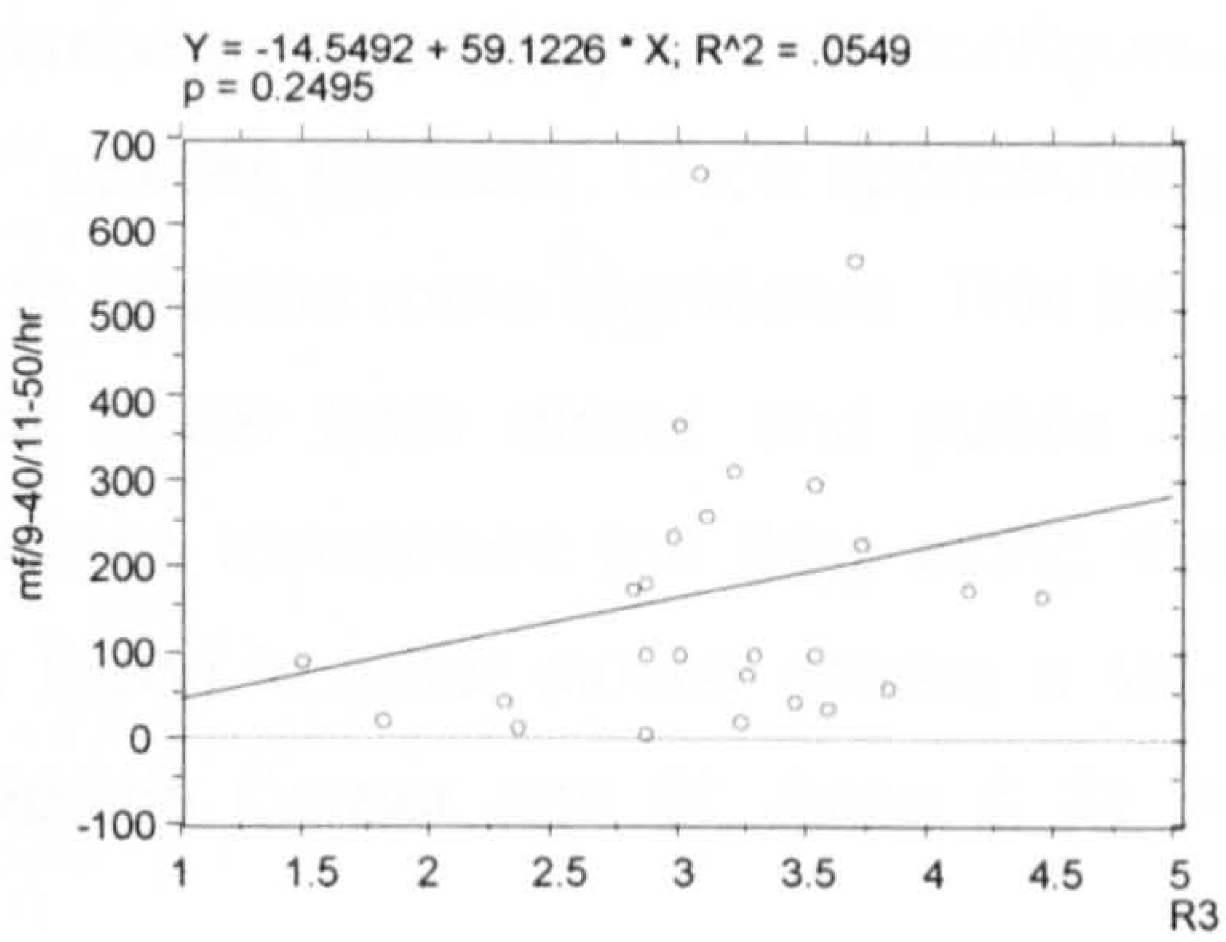

Figure 5.15. Scattergram R3 and mean n° moving people for 9.40 to 11.50 am, public space

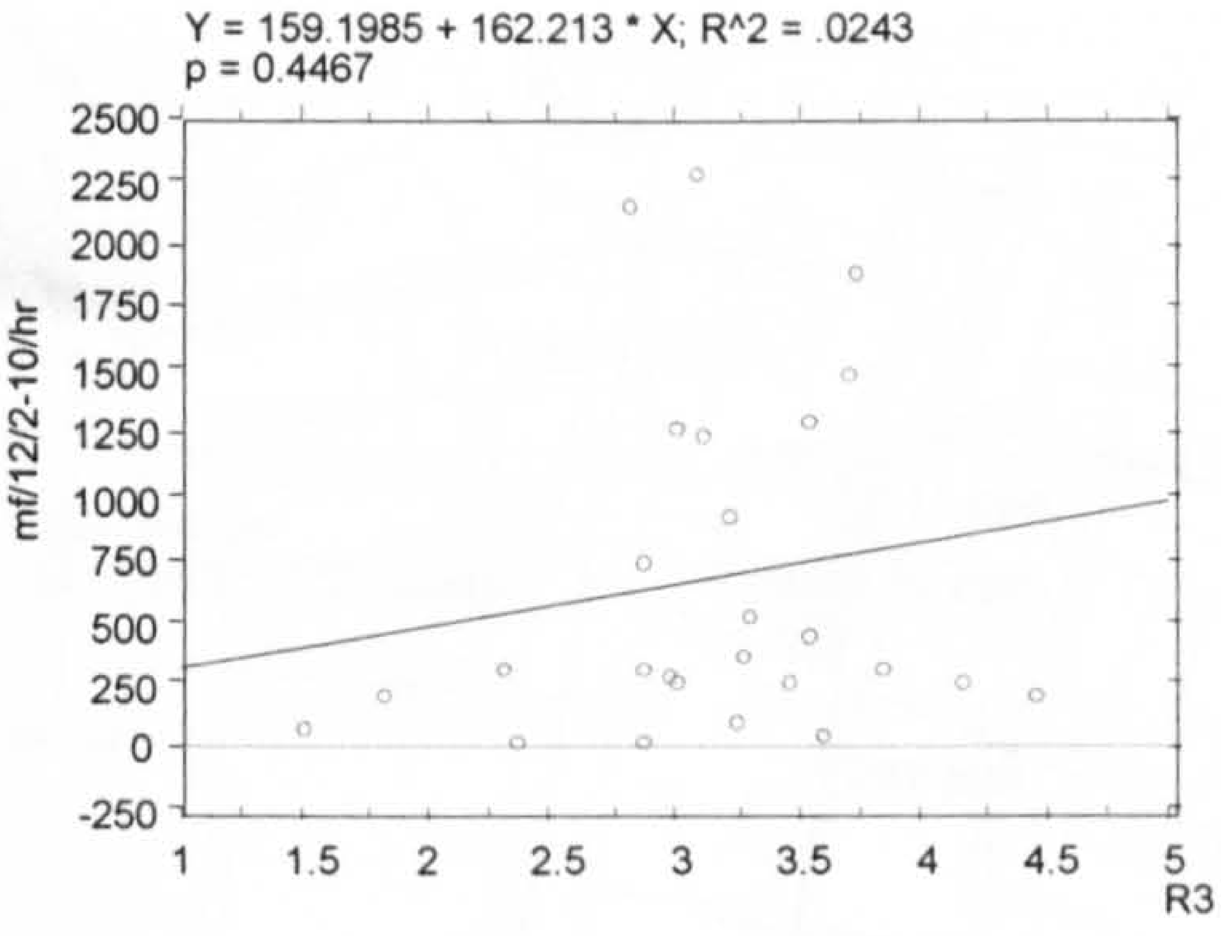

Figure 5.16. Scattergram R3 and mean nº moving people for 12 to 2.10 pm, public space

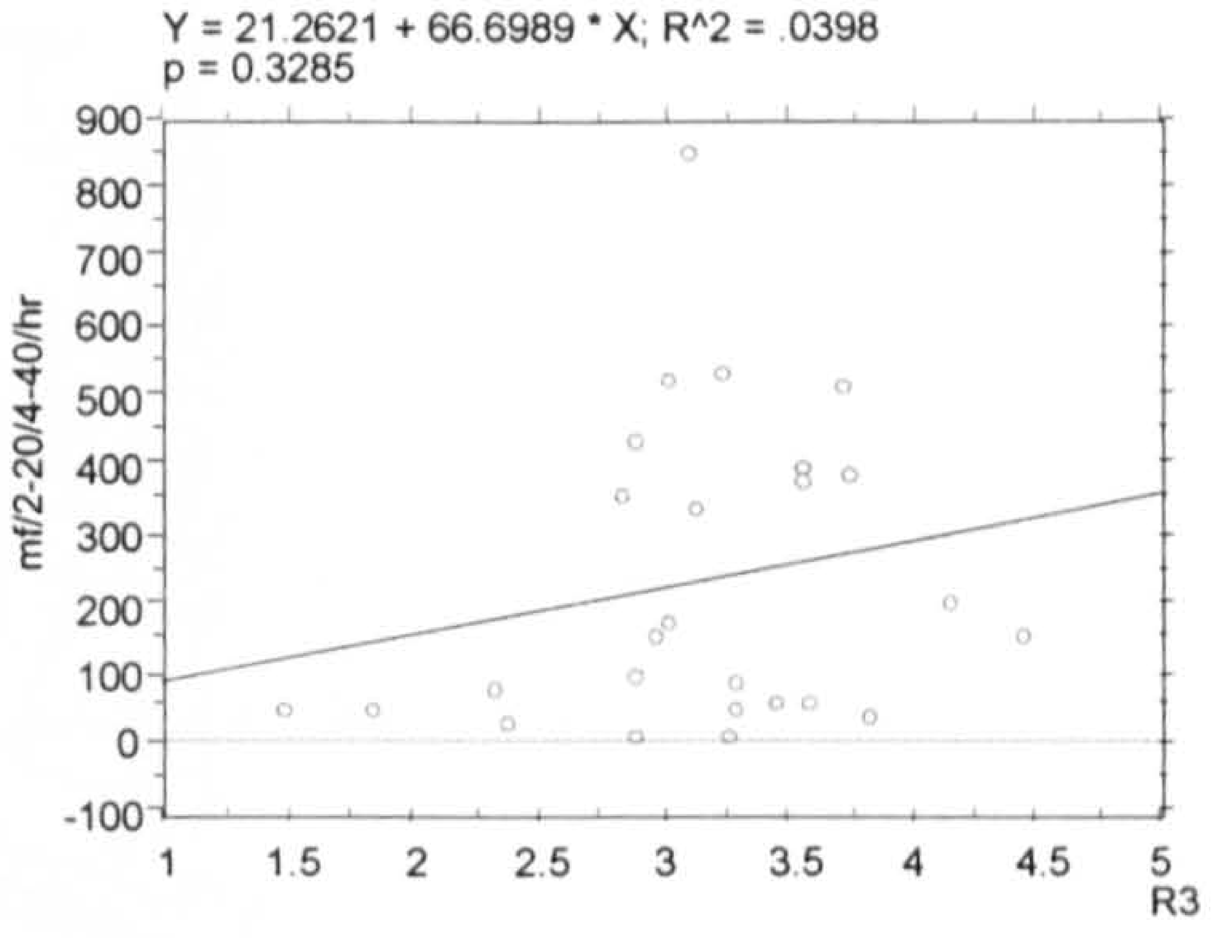

Figure 5.17. Scattergram R3 and mean nº moving people for 2.20 to 4.40 pm, public space

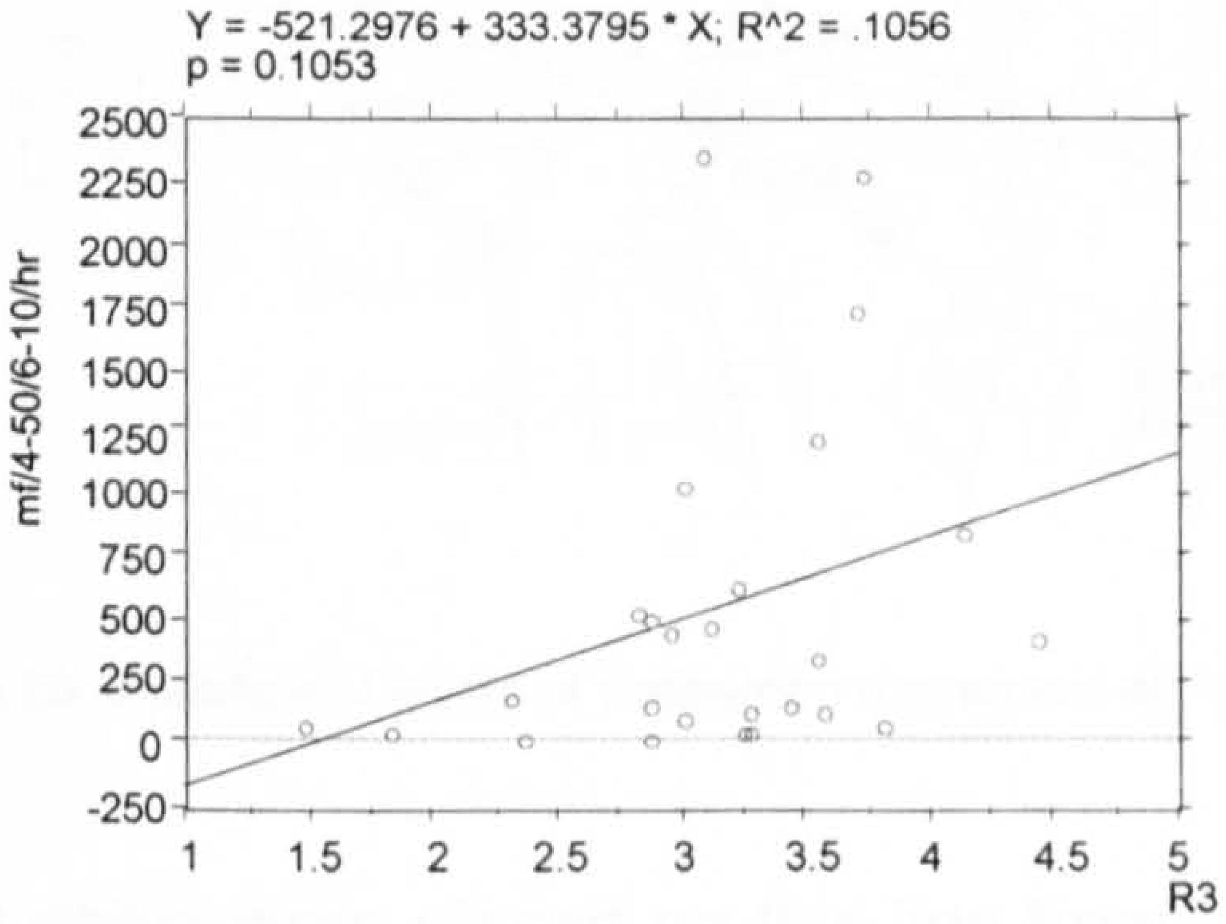

Figure 5.18. Scattergram R3 and mean nº moving people for 4.50 to 6.10 pm, public space

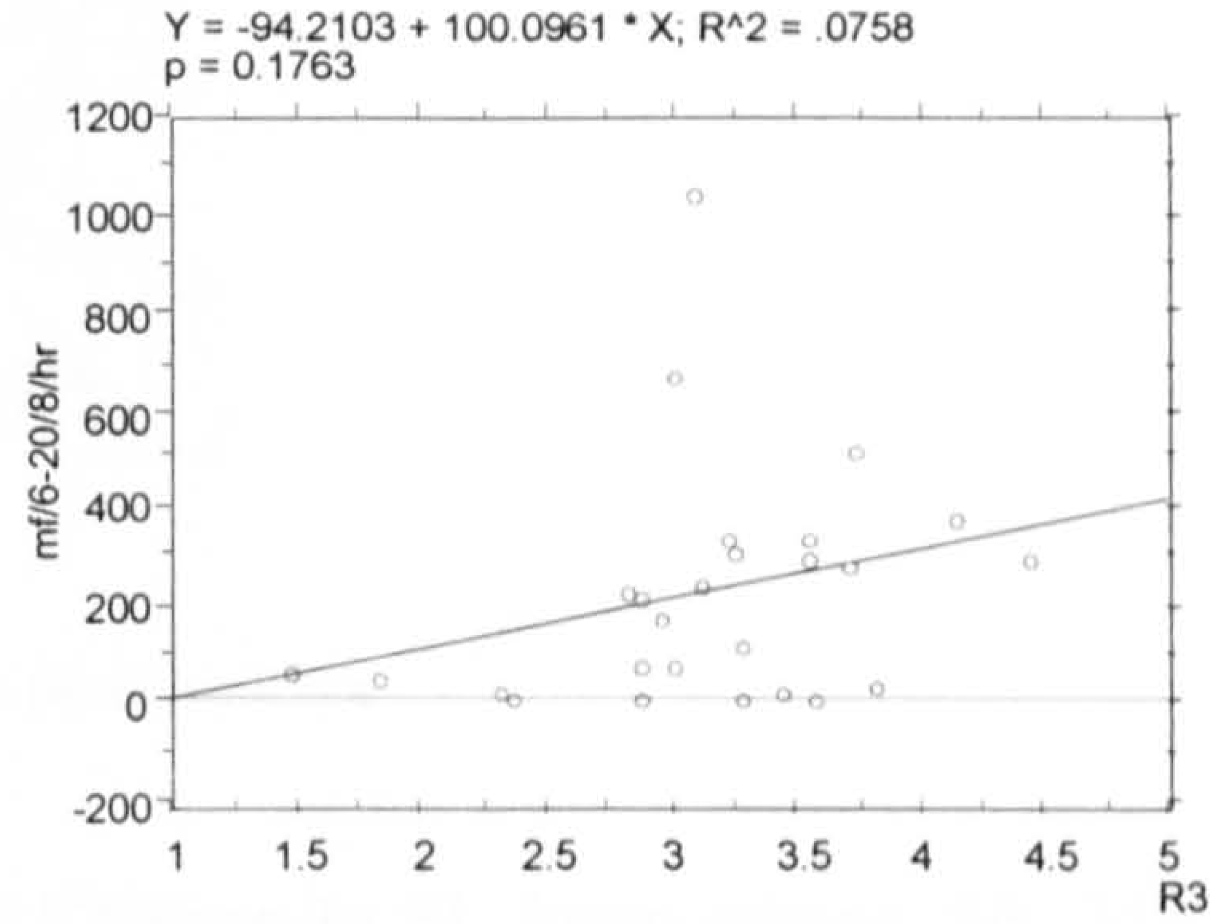

Figure 5.19. Scattergram R3 and mean nº moving people for 6.20 to 8 pm, public space

Examining all scattergrams, the distribution of points indicates a strong division for pedestrian distribution inside the public spaces. One possibility is that, somehow, pedestrians are spatially distributing themselves according to the configurational properties of the urban grid along the "linear" spaces (streets). Once approaching "non linear" public spaces, other properties seem to become more significant. This becomes very clear when analysing axial lines that cover both street and public spaces segments together with the levels of pedestrian movement (all day) along them. A typical example (and the same pattern was found in other similar cases) is the axial line that interfaces with New Change/Cheapside Corner and St. Anne & St. Agnes churchyard (Fig. 5.20) next.

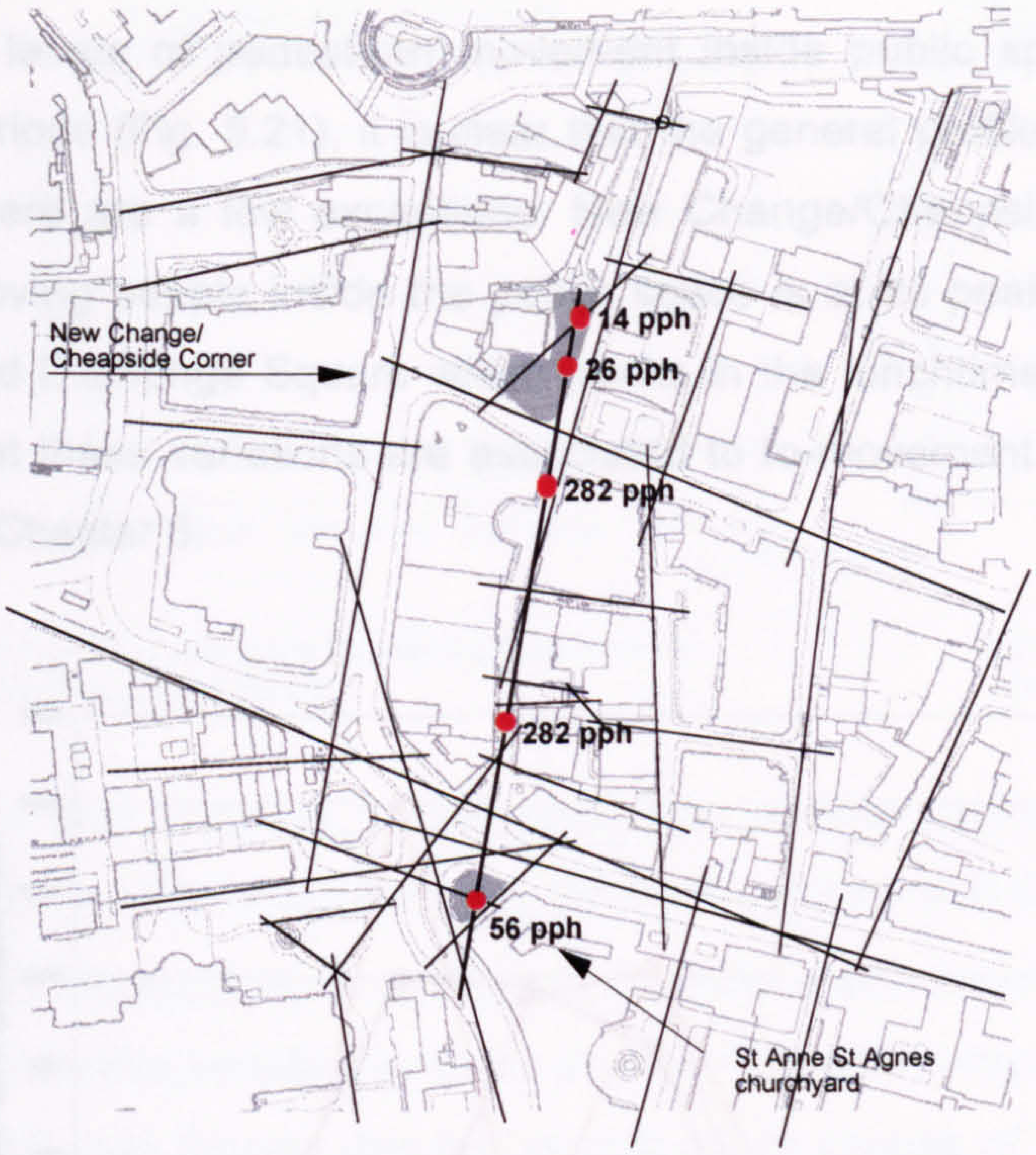

Fig. 5.20. Variation of levels of pedestrian movement along the same axial line

Five gates were placed on this line from New Change to St. Anne where, 56, 282, 282, 26 and 14 pph (all day) were observed. The difference in the mean number of people in street gates compared to inside public space gates is substantial; the mean number of pedestrians along the street gates is far superior to the ones inside public spaces. This behaviour may be related to the detailed spatial elements of the public spaces themselves, where certain routes are prioritised against others.

Nevertheless, so far it has not being possible to establish a model for predicting the number of moving people inside public spaces by correlating levels of moving people against integration values of axial lines. The next step of this study investigates the relationship between the number of moving people inside the public spaces and their morphological properties with respect to size, visual fields and enclosure ratio. Also, the extent to which the number of moving people inside the public spaces might be related to interfacing axial lines properties will be investigated, specifically the global integration value of the main line crossing the space and the strategic value (Hillier, 1984).

The analysis for the levels of pedestrian movement for both inside and around the public spaces has shown that although there is a diurnal pattern, the variation on levels of pedestrian movement is comparatively the same for individual locations. If we look at levels of pedestrian movement inside public spaces according to specific time periods (Fig. 5.21), it is clear that the general profile is constant for all public spaces. There are a few exceptions: New Change/Cheapside Corner, where the number of moving people inside the public space is at its peak for the 6:20 – 8 pm time period and Exchange Square which peaks in the lunchtime period. However, it is very likely that these variations are associated to to-movement, which will be discussed in detail in Chapter 6.

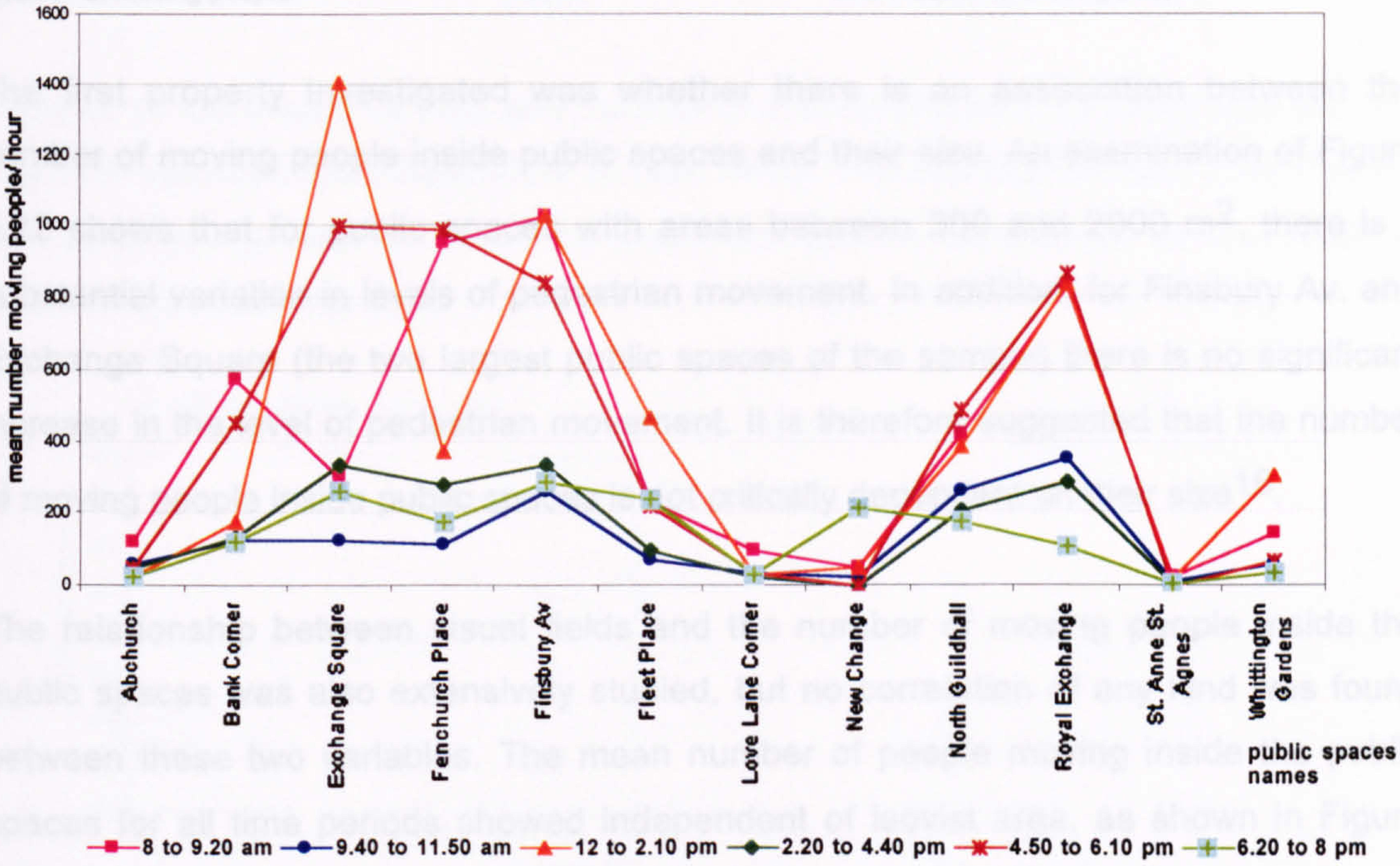

Figure 5.21. Linear plot illustrating the number of moving people inside the selected public spaces according to time periods

On the basis of this trend, the analysis will be restricted to the all day period (8 am – 8 pm) with the mean number of moving people presented for the hourly rate. The analysis begins by looking at the correlation between the mean number of moving people against the size of public spaces, the size and length of respective convex isovists and enclosure ratio.

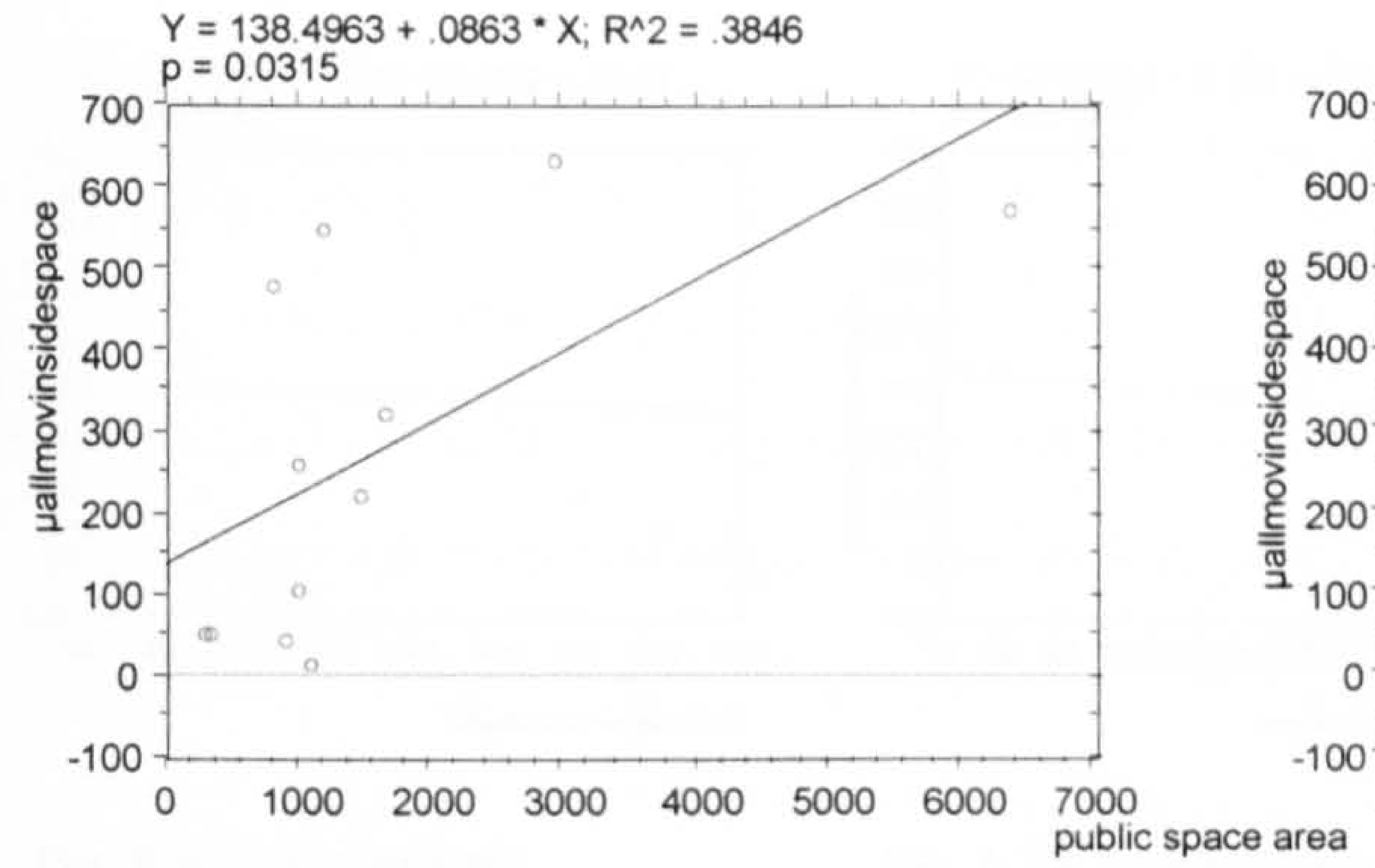

Figure 5.22. Scattergram for public space area and mean nº of moving people

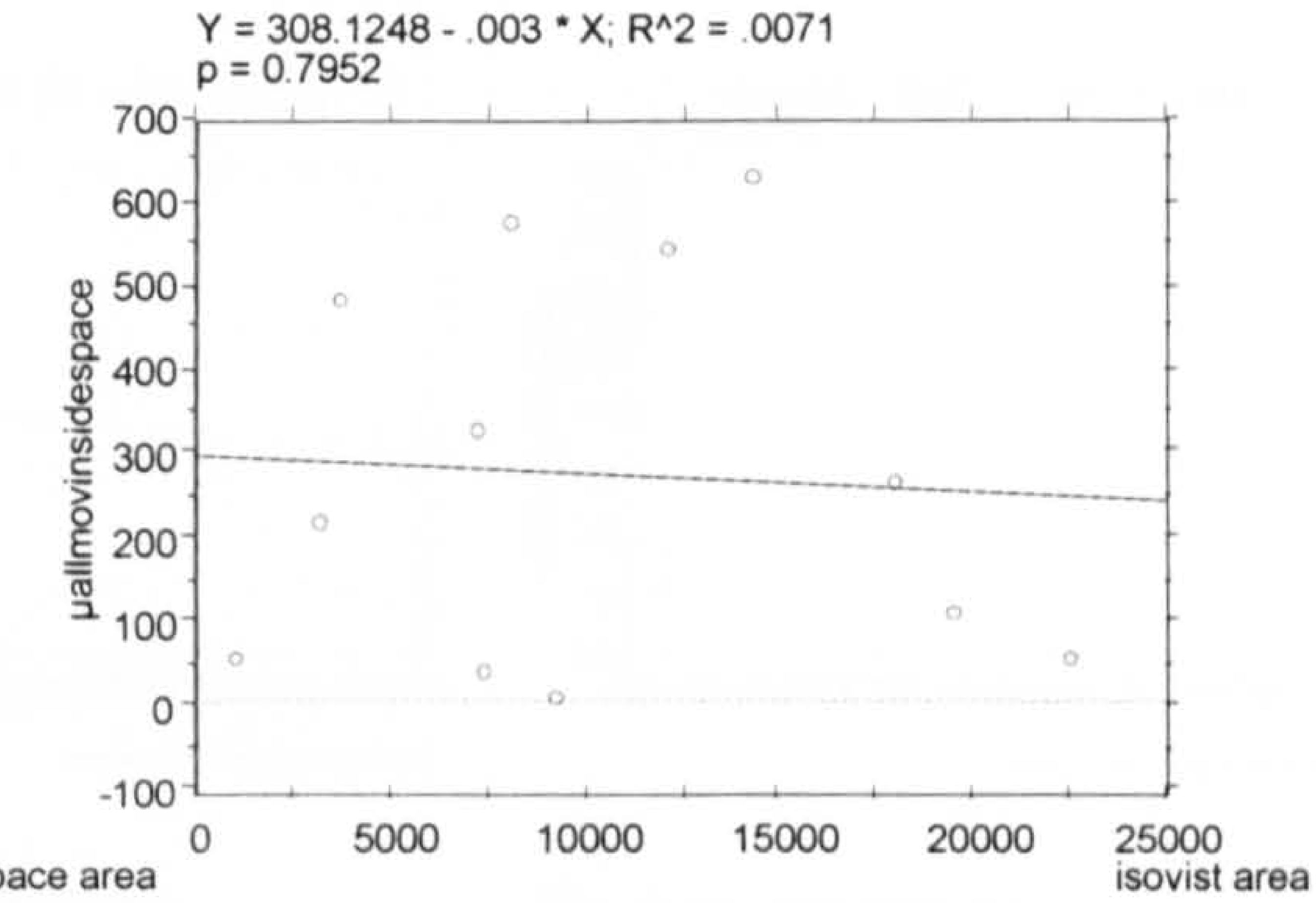

Figure 5.23. Scattergram isovist area and mean nº of moving people

The first property investigated was whether there is an association between the number of moving people inside public spaces and their size. An examination of Figure 5.22 shows that for public spaces with areas between 300 and 2000 m^2, there is a substantial variation in levels of pedestrian movement. In addition, for Finsbury Av. and Exchange Square (the two largest public spaces of the sample) there is no significant increase in the level of pedestrian movement. It is therefore suggested that the number of moving people inside public spaces is not critically dependent on their size[16].

The relationship between visual fields and the number of moving people inside the public spaces was also extensively studied, but no correlation of any kind was found between these two variables. The mean number of people moving inside the public spaces for all time periods showed independent of isovist area, as shown in Figure 5.23 above. Likewise, no correlation between the sum of isovist lengths and mean of isovist lengths for all three methods discussed previously was found. Figures 5.24 to 5.29 summarise these findings.

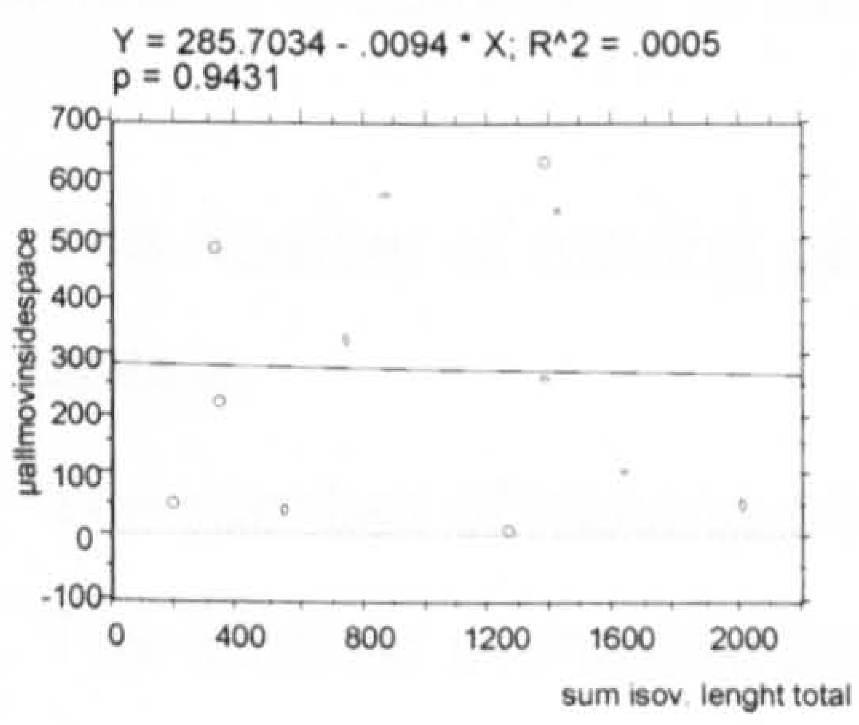

Fig. 5.24. Scattergram sum isovist length (total) and mean number moving people

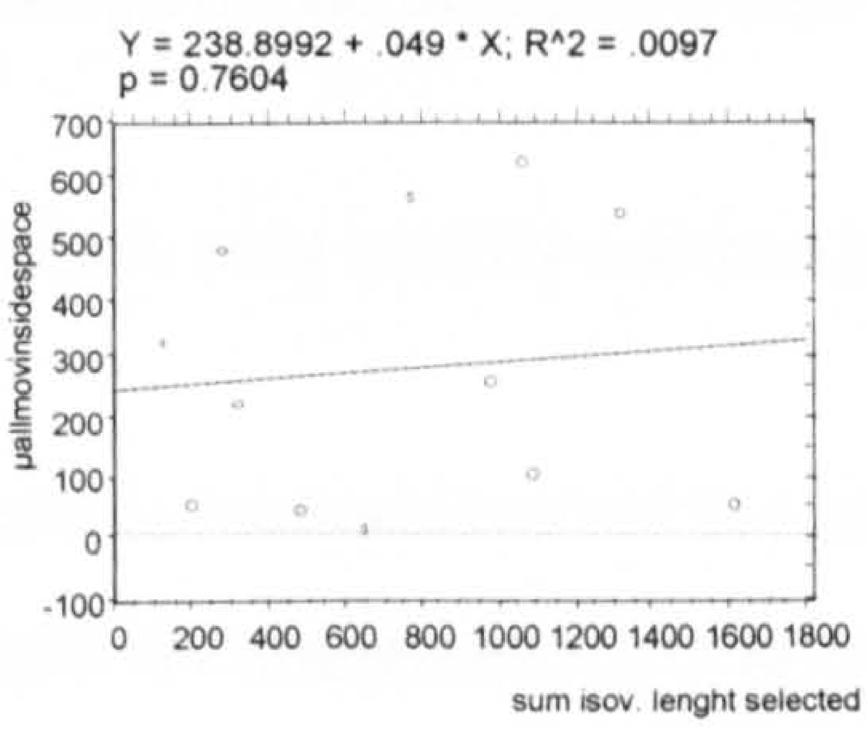

Fig. 5.25. Scattergram sum isovist length (selected) and mean number moving people

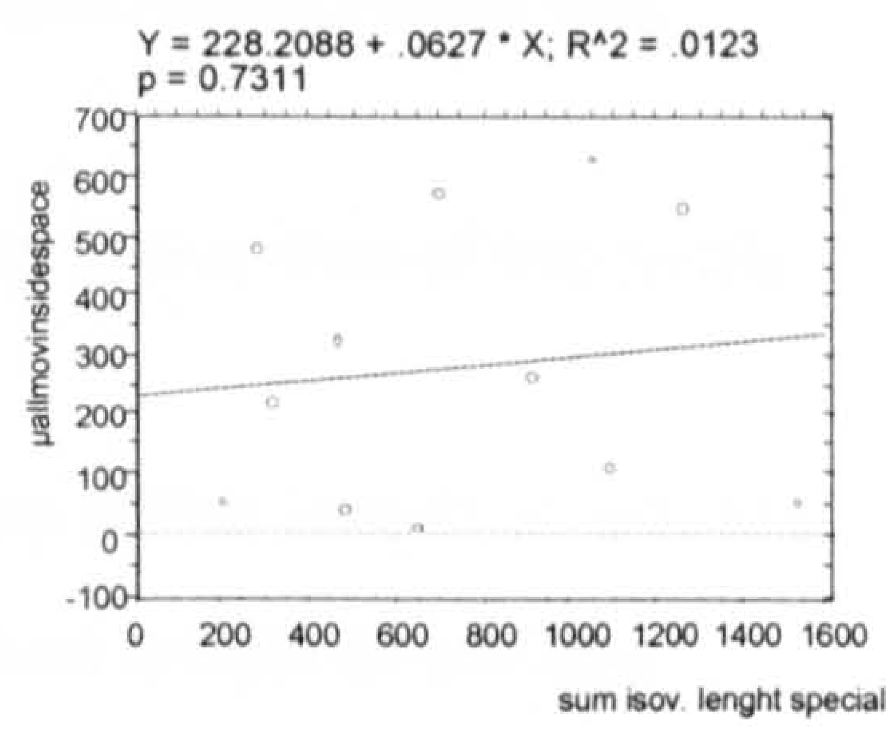

Fig. 5.26. Scattergram sum isovist length (special) and mean number moving people

16 The data was tested for the natural log for moving people with negative results.

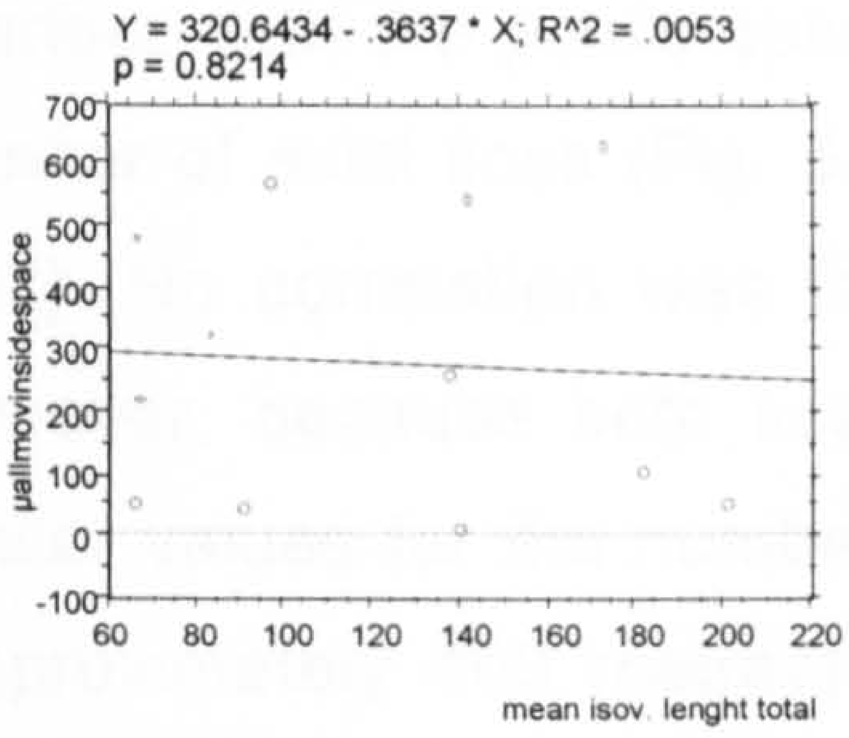

Fig. 5.27. Scattergram mean isovist length (total) and mean number moving people

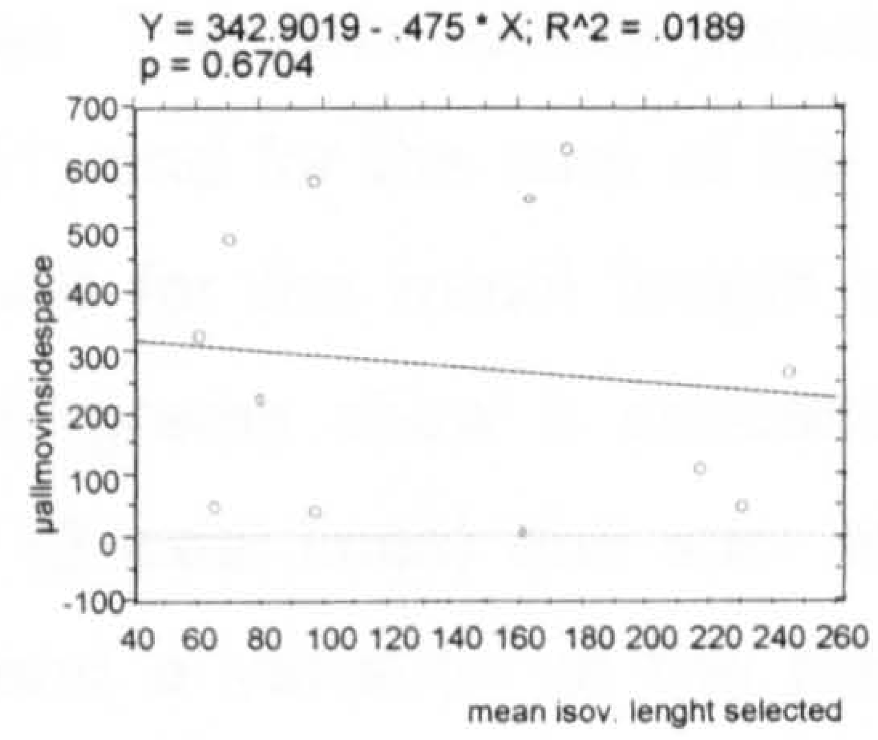

Fig. 5.28. Scattergram mean isovist length (selected) and mean number moving people

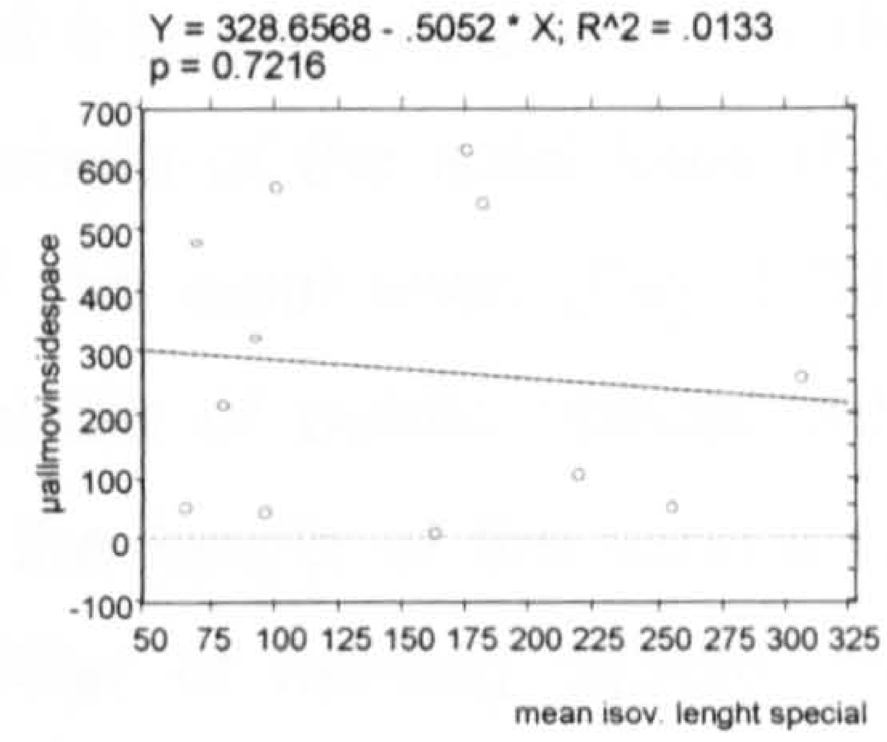

Fig. 5.29. Scattergram mean isovist length (special) and mean number moving people

Analysis of the enclosure ratio and number of moving people (Fig. 5.30) also showed that both variables are independent of each other. The scattergram also illustrates the two distinctive groups as far as the enclosure ratio is concerned, as discussed in Chapter 4 (Section 4.5.1.2).

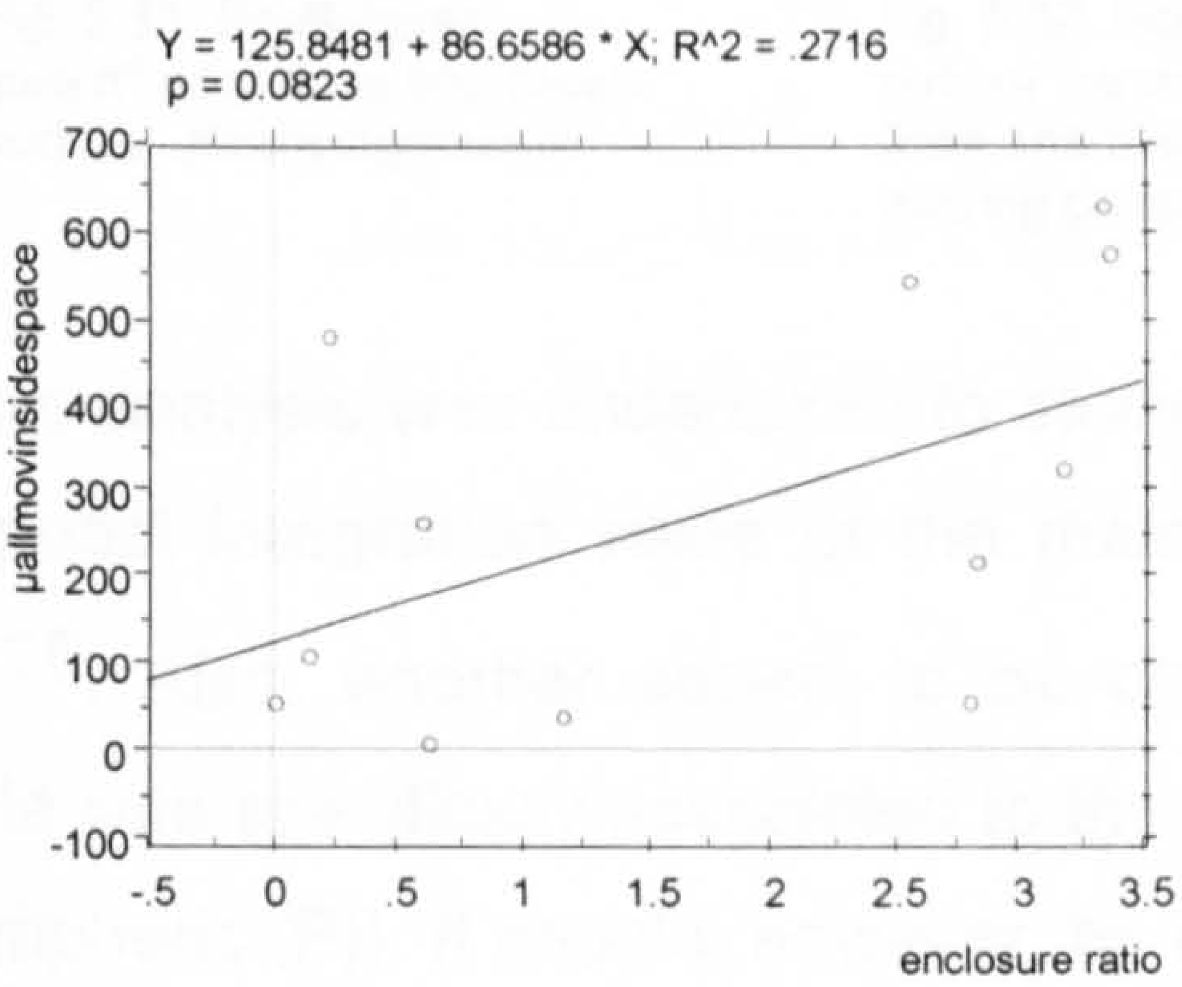

Figure 5.30. Scattergram enclosure ratio and mean number of moving people

Therefore, in summary, at this stage of the analysis it has been established that:

- The number of moving people is only weakly associated to the size of the public space.
- The number of moving people is independent of the sum of the length of isovists.
- The number of moving people is independent of the mean length of isovists.
- The number of moving people is independent of the enclosure ratio.

So far, levels of pedestrian movement showed unrelated to the convex and isovist properties as previously examined in Chapters 3 and 4. The investigation proceeds by looking at the correlation between the mean number of moving people (in all cases the data is given for the hourly rate) and the number and the length of the axial lines that interface with the public spaces. The data results showed a linear correlation for the number of axial lines (Fig. 5.31) and for the sum of the length of the axial lines (Fig. 5.32). No correlation was found for the mean length of the axial lines (Fig. 5.33). However, because both scattergrams show a concentration of public spaces with similar values for the number (3 axial lines) and sum of the length of the axial lines (approximately 400 metres) and a variation of the number of moving people, the Kendal test was applied to verify the results. In both cases, the results showed an association between the variables[17].

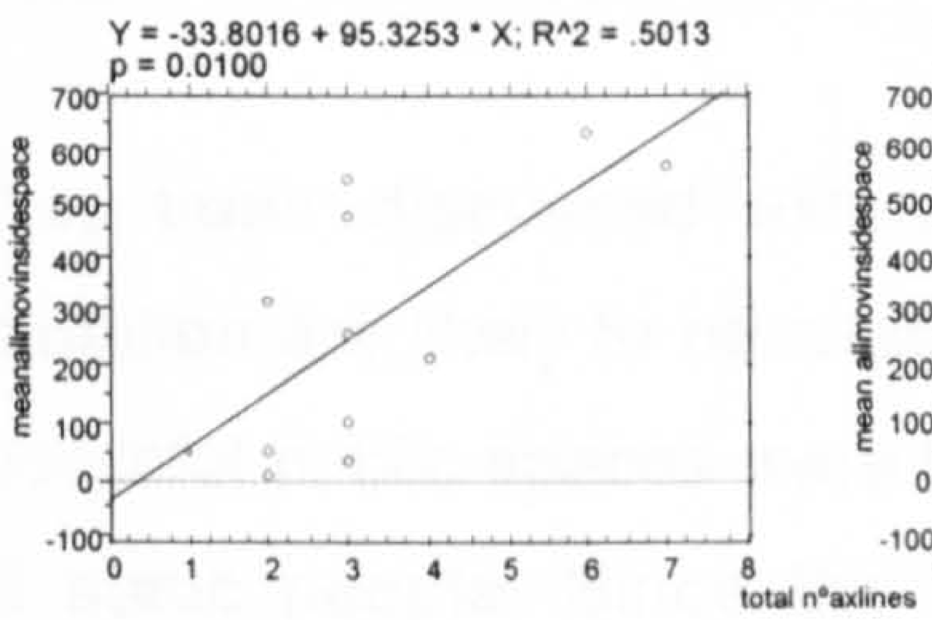

Fig. 5.31. Scattergram sum n° axial lines and mean number of moving people

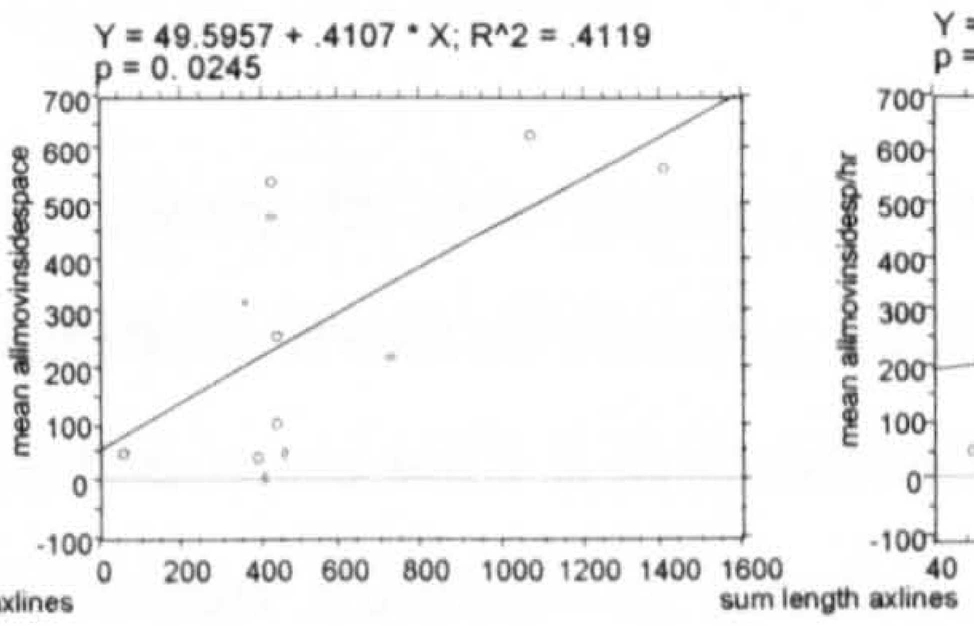

Fig. 5.32. Scattergram sum of the length of the axial lines and mean number of moving people

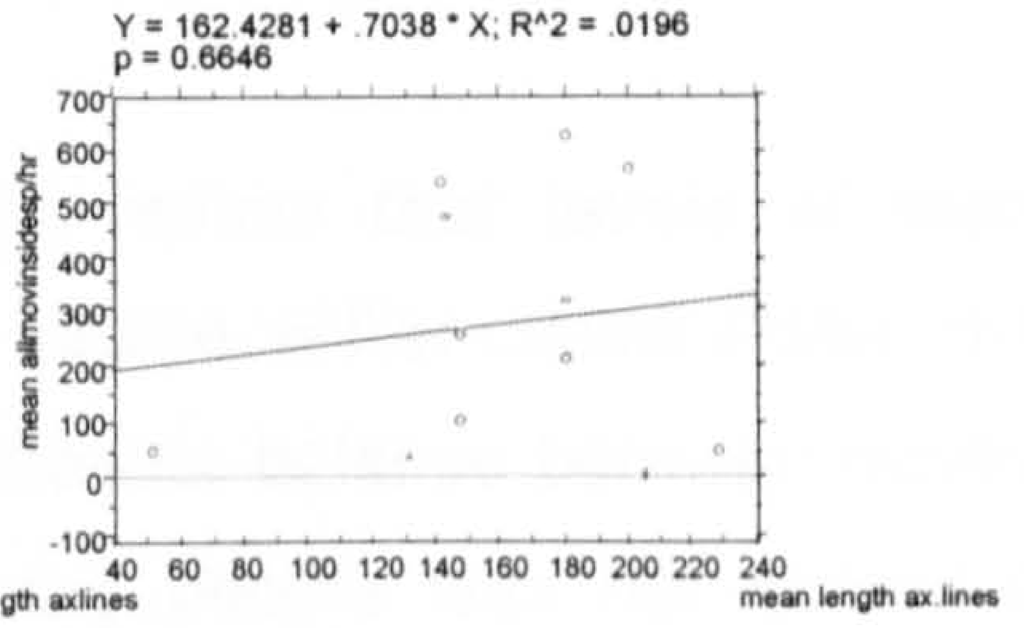

Fig. 5.33. Scattergram mean sum of the length of the axial lines and mean number of moving people

Further analysis was undertaken to study the relationship between moving people and the global integration value of the main line interfacing with the public space (Fig. 5.34)[18]. Also, another aspect to be considered is whether the number of moving people was specifically associated to the axial line type (convergent (C), transverse (T) or peripheric (P)). It should, however, be noted that, as seen in Plate 5.3, public spaces in the City of London are essentially interfaced by transverse axial lines (hypothetically associated with through movement), which are present in 11 out of 12 cases. Convergent and peripheric axial lines are present in only 2 and 4 public spaces respectively, which renders the results statistically insignificant due to the low number of data. Therefore, the analysis is restricted to whether the total number of moving people correlates with the global integration value of T lines (Fig. 5.35). No correlation was found in both cases.

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[17] The results of the Kendal correlation analysis are: Sum of the number of axial lines: Tau corrected for ties = 0.5241 and p = 0.0335. Sum of axial lines lengths: Tau corrected for ties: 0.4544 and p = 0.0397.

[18] Hillier(1984) defines the "main line" as the axial line with the highest global integration value. See Section 2.5 in Chapter 2.

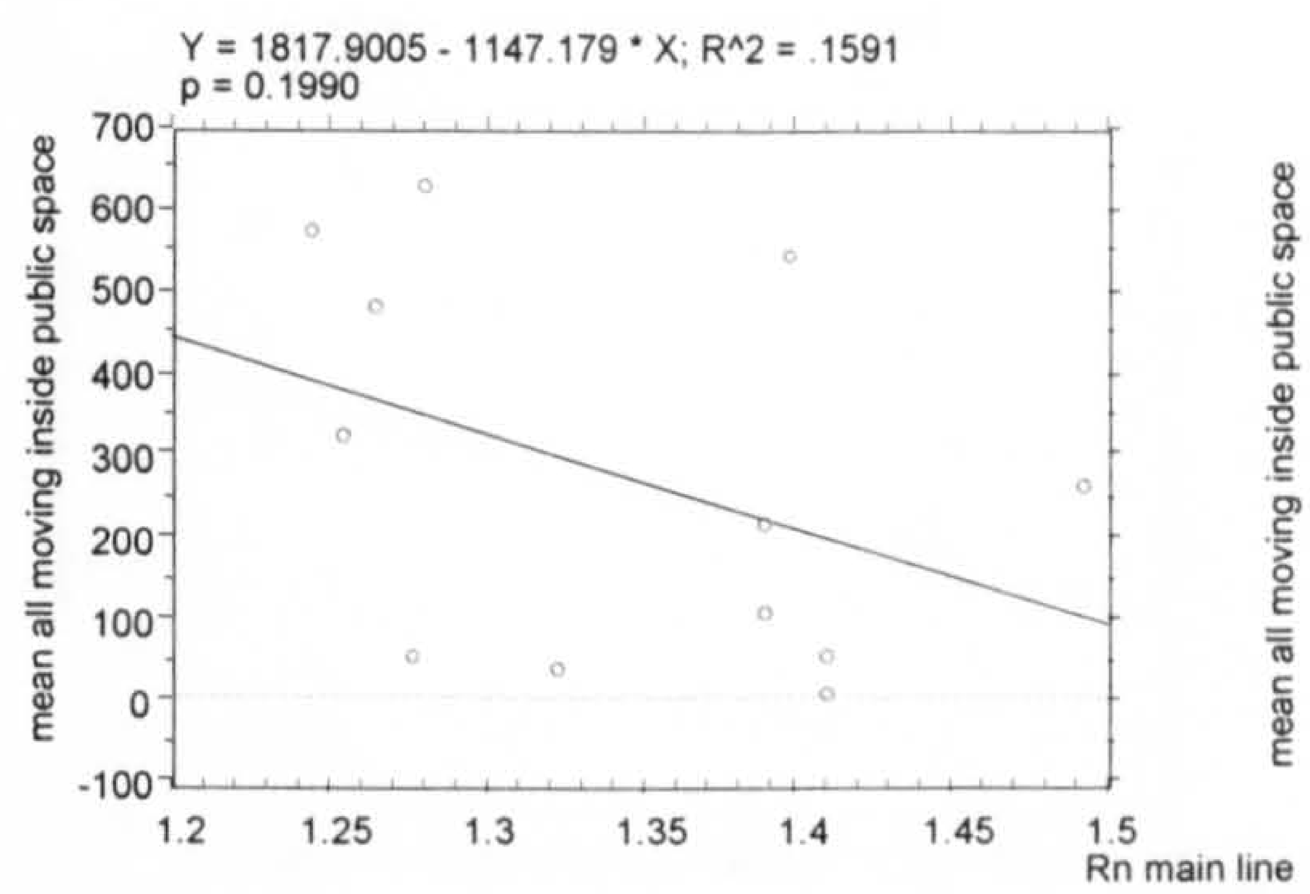

Figure 5.34. Scattergram Rn main axial line and mean number of moving people

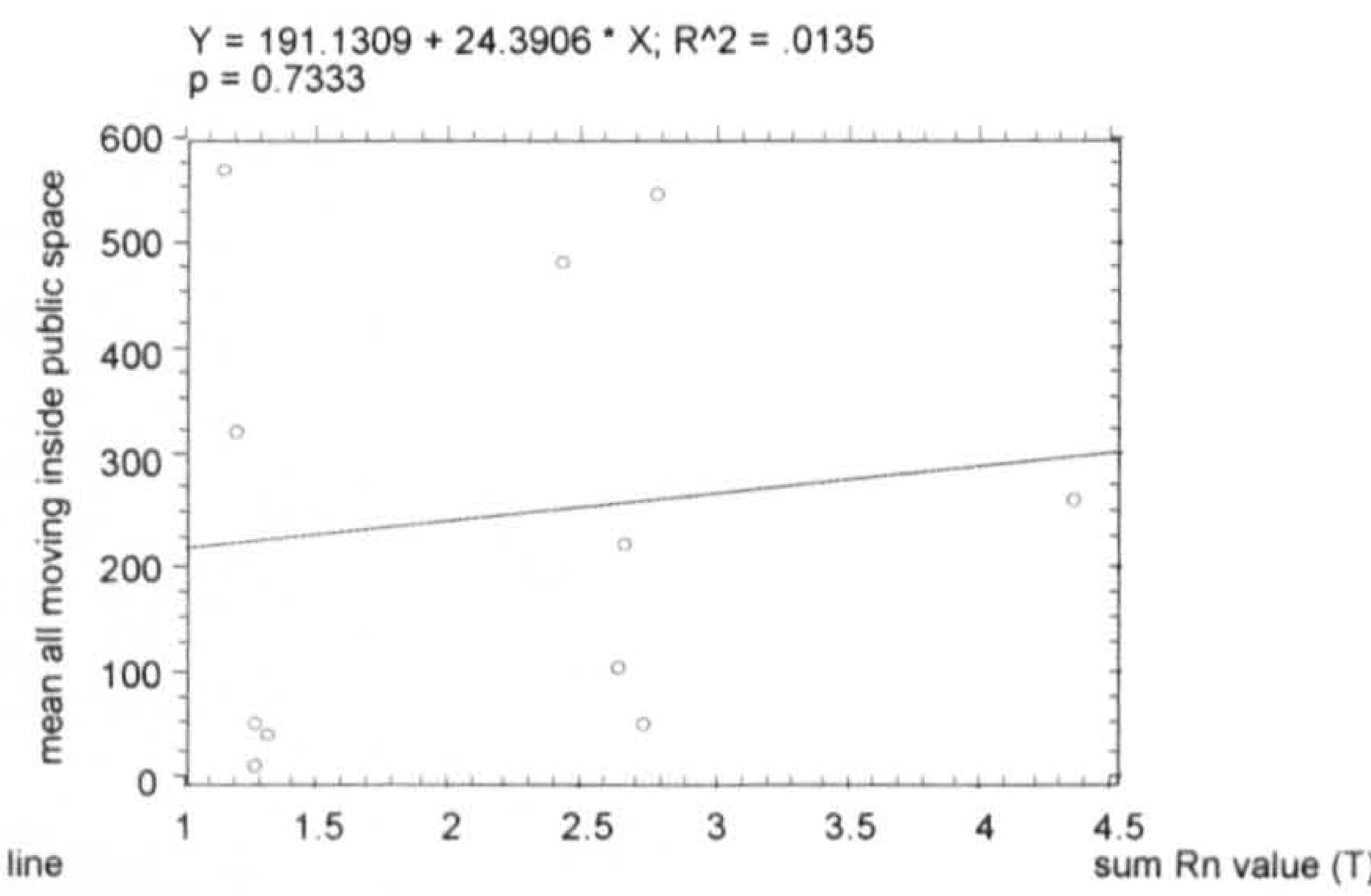

Figure 5.35. Scattergram sum Rn T axial lines and mean number of moving people

It has been discussed extensively in the literature review that levels of static occupation are likely to be related to levels of moving people. Hillier claims (1984) that successful public spaces were the ones with a proportionate balance between moving and static people. Since the mean number of moving people was not related to individual values of axial lines; the strategic value, conjectured to be an important property for static occupation, was tested. As expected, the analysis showed a good positive linear correlation between the number of moving people and strategic value, seen in Figure 5.36. The same positive results were also found when assessing the relationship for the local strategic value (Fig. 5.37).

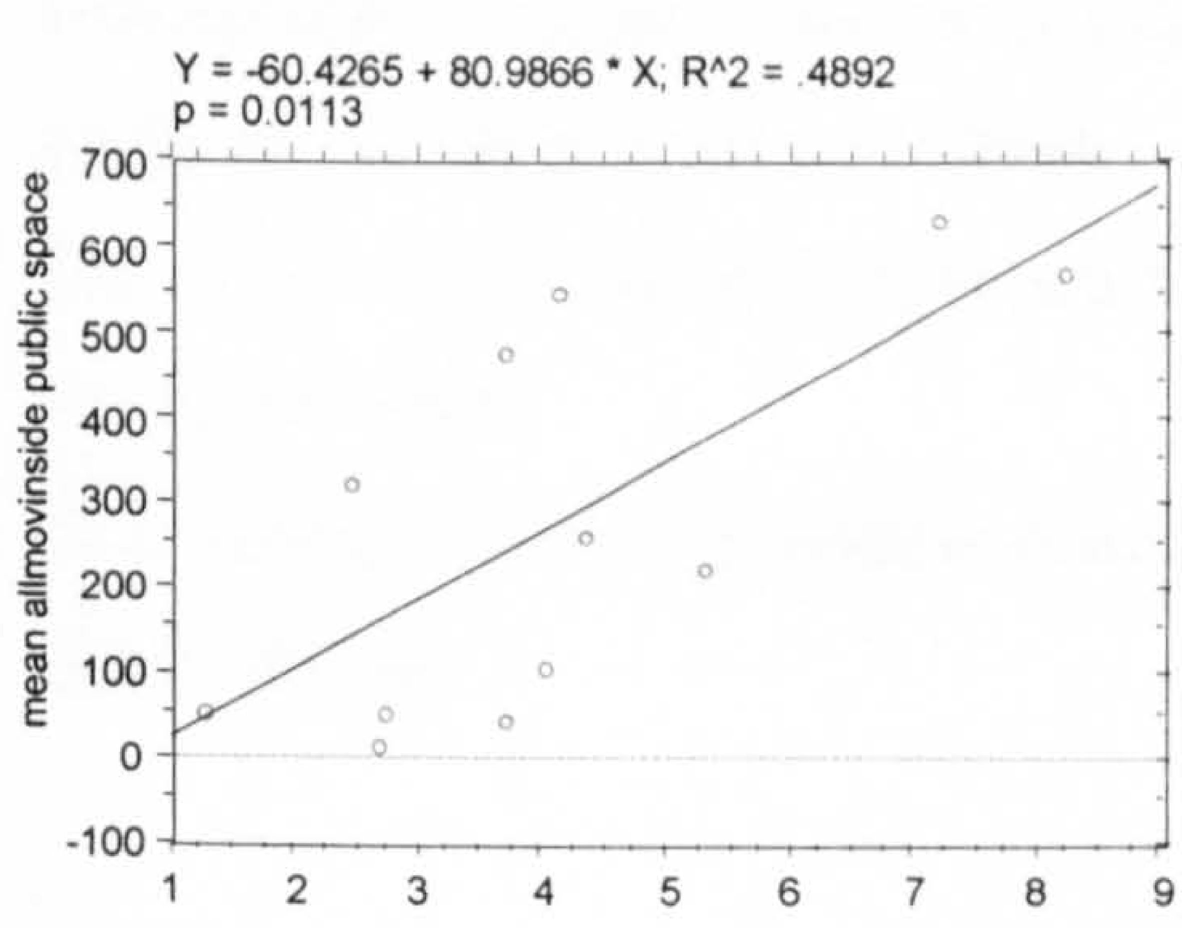

Figure 5.36. Scattergram strategic value and mean number moving people

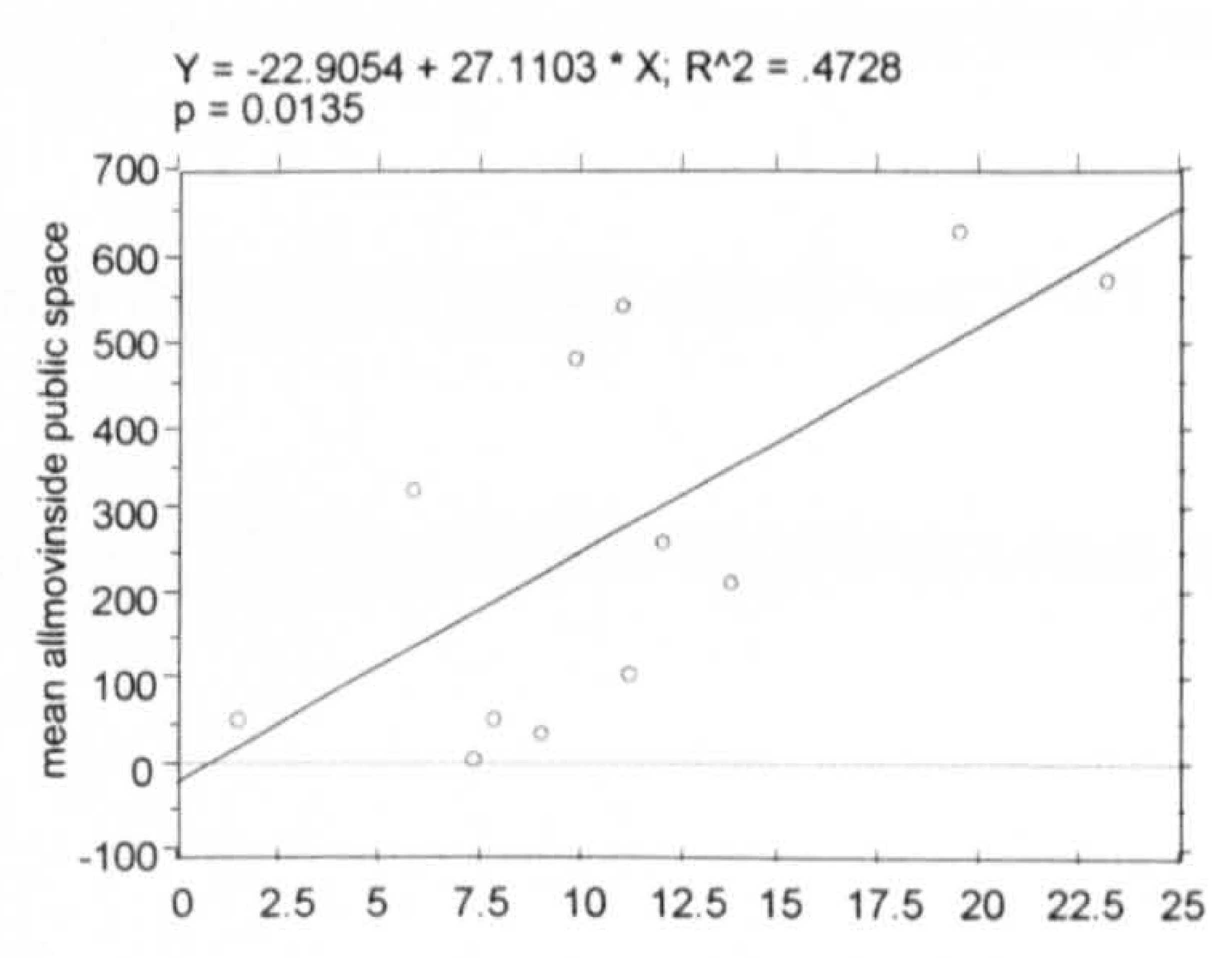

Figure 5.37. Scattergram local strategic value and mean number moving people

Lastly, to analyse the embedding property, the number of moving people was correlated against the integration value of the public space. The result (Fig. 5.38) showed that there was no correlation between the two variables.

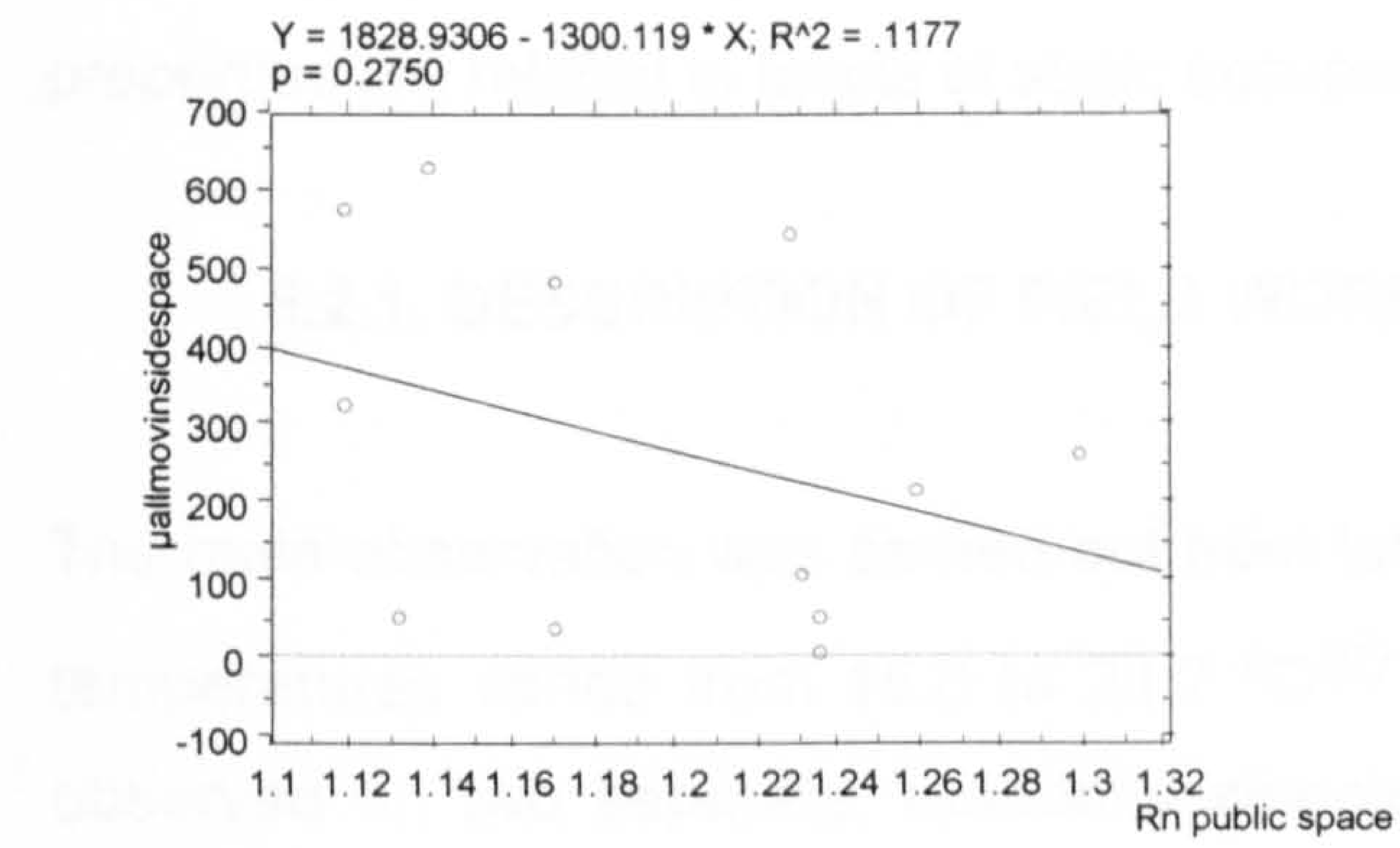

Figure 5.38. Scattergram global integration value of public space and mean number of moving people

With respect to the levels of pedestrian movement inside the public spaces in the City of London and the axial lines that interface with them, it is suggested:

- The larger the number of axial lines, the larger the number of moving people.
- The number of moving people is associated to the sum of the length of axial lines.
- The number of moving people is independent of the mean of the sum length of the axial lines.
- The number of moving people is independent of the global integration value of the main line.
- The number of moving people is independent of the sum of the global integration value of the transverse axial lines.
- The number of moving people is a function of both strategic value and local strategic value.
- The number of moving people is independent of the global integration value of the public space.

5.2 LEVELS OF STATIC OCCUPANCY

The aim of this section is to study the relationship between public spaces spatial form and the way they are embedded in the urban grid and levels of static occupancy. Ideas about the relations between convex and axial structure and levels of spatial use, first set out in the Mansion House Square Study (Hillier, 1984), constitute the basic theoretical framework. Section 5.2 follows the same structure applied in the analysis of levels of pedestrian movement. After presenting the data collected during the fieldwork, an ethnographic description of levels of static use is given. The issue of which spatial properties are related to levels of static occupancy is then investigated.

5.2.1. DESCRIPTION OF FIELD WORK

The main observation was carried out from late July to early August 1996[19], the mean temperatures varied from 16.6 to 24.7 °C[20] for this period. Each public space was observed on two separate, randomly selected days. Static people within the public spaces were observed from 8 am until 8 pm every ten minutes, totalling 51 rounds each day for each public space. The data was recorded on a spreadsheet according to type of users, gender, position (sitting or standing) and activities[21]. A second observation was carried out during early October 1996[22] when the mean day temperature was lower, ranging from 11.3 to 16.3 °C[23]. The purpose was to investigate whether the number of static people amongst the twelve public spaces would keep the same profile on colder days. Each public space was again observed for two separate days, randomly selected. Static people within the public spaces were observed during lunchtime, from 11:30 am until 2:30 pm, numerically recorded on a spread sheet according to type of users, gender, position and activities as before, with a total of six rounds each day.

Previously, in May 1996[24], a small pilot study was carried out to construct an initial picture of the likely users of the City of London's public spaces, in order to assist the planning of the main field work. In this pilot study, the number of static people was recorded for three public spaces, Bank Corner, Finsbury Av. and NE St. Paul's. Seven main categories of users were identified, divided into two main groups: regular and occasional users.

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19 The observation was carried out between July 17th and August 22nd, 1996.

20 Data provided by the Meteorological Office.

21 During this period, for ten time slots, static people were also recorded according to their location. This element constitutes the main information used in Chapter 6 on patterns of static people occupancy of public spaces.

22 The observation was carried out between October 21st and October 30th, 1996.

23 Ibid. 20.

24 The observation was carried out between May 7th and May 9th, 1996.

The regular users are the focus of this research, that is, the City workers. This includes anyone who is an inhabitant of the City environment, from stockbrokers to bank cashiers and shops assistants. The regular users (City workers), referred to as the "suits" category, were sub-divided into two groups: suits not using the facilities of the wine bars or pubs, referred to as "suits not at pubs" and suits specifically using the facilities of the wine bars or pubs, referred to as "suits at pubs". The reason for differentiating between City workers on the basis whether they use the catering facilities is to have a realistic framework for comparing public spaces with and without public houses or wine bars which could be enhancing the overall number of static people in a particular public space.

The occasional users, that is, the visitors, were divided into three groups: "Tourists", "others" (which includes mainly couriers and construction workers) and "office smokers". The office smokers' category (although City workers) was added because an increasing number of City workers, generally in groups, was observed using the public spaces simply as a result of non-smoking policies, which vary depending on time and place. Nevertheless, these users are driven by specific desires, and as a unique type of user shall be dealt with as an independent case.

The number of static people used to evaluate the performance of public spaces was calculated by dividing the total number of static people recorded (which was firstly averaged from two days of data) by the number of observation rounds (all day or according to time periods). A comprehensive summary of the data collected for the twelve public spaces during July/August and October is shown in Tables 5.4 and 5.5 respectively[25].

Each table gives a description of the mean number of observed people according to categories[26]. The "all" column accounts for the sum of suits, tourists, office smokers and others.

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[25] Note that the mean number of static people for July/August is for the whole day, except for the last column, whereas the October data covers only the lunchtime period. This explains why some public spaces have a higher number of static people for the October data compared to the July/August one. For more detail on levels of static occupancy, refer to Plates 5.5 to 5.16 in Appendix 3.

[26] It was not the purpose of this research to specifically investigate whether there are differences in how men and women perceive and use public spaces. For specific studies on the subject refer to Mozingo, 1989; Frank and Paxson, 1989; and Marcus and Francis, 1990, p23.

Public space name	Mean nº people: all	Mean nº suits	Mean nº suits not at pubs	Mean nº suits at pubs	Mean nº tourists	Mean nº office smokes	Mean nº people: others	Mean nº suits 8-4:40
Abchurchyard	3.44	3.14	3.12	.02	.05	.25	.01	3.86
Bank Corner	24.19	17.79	17.79	•	1.83	.02	4.54	19.77
Exchange Square	86.50	81.28	26.45	54.83	.39	.85	3.97	60.69
Fenchurch Place	17.48	16.70	8.80	7.89	.04	.07	.68	19.54
Finsbury Av.	76.22	75.01	20.45	54.56	.31	0	.89	61.13
Fleet Place	19.13	18.25	5.30	12.94	.06	.46	.36	13.69
Love lane Corner	9.52	9.05	9.05	•	.04	0	.43	11.27
New Change	17.27	16.98	3.02	13.96	.29	0	0	11.54
North Guildhall	4.98	3.85	3.85	•	.18	0	.95	4.92
Royal Exchange	34.35	30.29	9.70	20.60	.91	.31	2.83	28.42
St. Anne	5.42	4.16	4.16	•	.05	0	1.22	5.26
Whittington Gds.	33.78	33.13	9.33	23.79	.06	0	.60	28.36
MEAN ALL CASES	27.69	25.80	10.09	23.57	.35	.16	1.37	22.37

Table 5.4. Summary table for mean number of static people per public space all day during July and August 1996
Obs. Unless otherwise indicated, the number of static people is for 8 am to 8 pm

Public space name	Mean nº people: all	Mean nº suits	Mean nº suits not at pubs	Mean nº suits at pubs	Mean nº tourists	Mean nº office smokers	Mean nº people - others
Abchurchyard	4.17	4.08	4.08	0	0	.08	0
Bank Corner	32.42	16.42	16.42	•	3.25	0	12.75
Exchange Square	82.83	80.42	55.00	25.42	0	.83	1.58
Fenchurch Place	12.50	11.92	10.75	1.17	0	.08	.50
Finsbury Av.	15.58	14.42	8.92	5.50	0	.25	.92
Fleet Place	9.92	8.92	4.42	4.50	0	.67	.33
Love Lane Corner	8.50	8.25	8.25	•	.25	0	0
New Change	6.00	5.33	3.92	1.42	.25	.42	0
North Guildhall	1.50	1.50	1.50	•	0	0	0
Royal Exchange	23.75	21.33	11.92	9.42	.58	.42	1.42
St. Anne	5.92	4.42	4.42	•	0	.17	1.33
Whittington Gds.	11.08	10.58	8.08	2.50	.17	0	.33
MEAN ALL CASES	17.85	15.63	11.47	6.24	.38	.24	1.60

Table 5.5. Summary table for mean number of static people per public space at lunchtime during October 1996 (11:30 am to 2:30 pm)

5.2.2. CITY OF LONDON PUBLIC SPACES: DESCRIPTION OF LEVELS OF STATIC OCCUPANCY

Following the previous approach, before engaging in the analysis of levels of static occupancy and spatial configuration, an ethnographical description of each public space is presented.

5.2.2.1. Abchurchyard

Abchurchyard seems to be a popular destination for City workers who work in the adjacent buildings with a non-smoking policy. It is also occupied occasionally by couriers who use the space to check destinations or other related matters. Despite the presence of a wine bar facing the public space, only on one occasion was a person seen drinking in the public space during the observation period. Also, despite the high population density of the surrounding office buildings, the public space is relatively empty and unused throughout the day. The level of static people is the lowest of all selected places. Naturally, the mean number of static people peaks at lunchtime, but again it is the place where the lowest mean number of static people was recorded. Conversely, although the mean number of static people decreases sharply after 5 pm, Abchurchyard has more people using the public space at this hour compared to two other cases of the sample, North Guildhall and St. Anne & St. Agnes churchyard.

5.2.2.2. Bank Corner

Bank Corner is a very popular destination for City workers. It is also occupied occasionally by couriers, and at the time of the observation, was a very popular destination for construction workers based nearby. The level of static people is the fifth highest for the whole sample and the highest for the public spaces that do not have catering facilities in the surrounding area, ahead of Fenchurch, Fleet Place, New Change/Cheapside Corner and Abchurchyard, all public spaces with wine bars. In addition, Bank Corner recorded the highest number of static people for the 8:00 to 9:20 am time period. When only "suits" not using the catering facilities are investigated, the mean number of static people is 17.79, behind only Finsbury Av. (20.46) and Exchange Square (26.45). The mean number of static people also decreases after 5 pm, with all public spaces without catering facilities, but is still relatively strong with 7.93 mean static people recorded between 6:00 pm and 8:00 pm. The ratio between static suits and casual visitors is 2.78, the lowest in the sample due to the strong presence of tourists and construction workers.

5.2.2.3. Exchange Square

Exchange Square shows very clear signs of being a place well consolidated as a destination for static activities in the City of London. A high number of women were observed coming to Exchange Square accompanied by young children, meeting their partners and enjoying the summer afternoon in the public space. This suggests that the public space was not only being used by the City workers nearby, but that its catchment area also is larger that most. It was also noticed, although this is not exclusive to Exchange Square, that the public space was used effectively from early in the morning. Empirical data showed that most of the people observed in the public space before 9:00 am were having something to eat. The level of static occupancy inside the public space is the highest of all cases with a mean of 86.50 (all static) throughout the day. When static people are divided into categories, Exchange Square is still a very popular destination with a mean number of 26.45 suits not at pubs and 54.83 suits at pubs all day. Exchange Square showed extremely high levels of suits at pubs after 5:00 pm. For the time slot of 12 - 2:10 pm, a mean of 76.35 suits at pubs was recorded, for the time slot of 5 - 6:20 pm a similar number was observed (81.80 suits at pubs), and from 6:20 - 8:00 pm, 188.57 suits at pubs were recorded. In contrast, the mean number of tourists is not high compared to other cases of the sample. A mean of 0.39 tourists was recorded throughout the day, compared to Bank Corner with a mean of 1.83.

5.2.2.4. Fenchurch Place

Fenchurch Place is used by a variety of City workers and appears to be less "elitist" than Exchange Square and Finsbury Av. When the mean number of suits not at pubs is compared to the mean number of suits using the catering facilities, both are very similar with 8.80 and 7.89 for the whole day. This indicates a good balance between the two categories. Fenchurch shows another interesting characteristic, also observed in Bank Corner, of people using public spaces as "waiting areas". The mean number of static people not at pubs for the 5:00 pm time slot is twice as much compared to people at pubs.

5.2.2.5. Finsbury Av.

The level of static occupancy (mean all day) is the second highest of all cases, with twice as many suits at pubs compared to suits not at pubs. Extremely high levels of suits at pubs were observed after 5:00 pm. For the 5 - 6:20 pm time period, 74.80 suits at pubs were recorded and from 6:20 - 8:00 pm, 104.86. If we look at the other categories, the data showed that there were on average 30.79 suits not at pubs for 6:20 to 8:00 pm, the highest of all cases. Like Exchange Square, the mean number of tourists is not high when compared to other cases of the sample. The ratio of suits to occasional visitors is 62.20, the highest of all cases, suggesting that Finsbury Av. is essentially frequented by City workers.

5.2.2.6. Fleet Place

Although close to St Paul's Cathedral, the number of tourists using the public space is very low with a mean of 0.06 tourists recorded throughout the day. This value is much lower than that of New Change/Cheapside Corner, another public space near St.

Paul's Cathedral (mean of 0.29 tourists throughout the day). Fleet Place has a high number of office smokers compared to the rest of the sample with a mean of 0.46 people, second in the sample after Exchange Square with 0.85. However, if we compare the number of office smokers to the number of all static people, office smokers in Fleet Place account for 2.4% compared to 0.98% for Exchange Square. The majority of people using the public space are wine bar users. The recorded number of suits not at pubs (all day) is almost half of the number registered for Love Lane Corner. After 5:00 pm, the users are limited to people using the wine bar.

5.2.2.7. Love Lane Corner

Love Lane seems to be a very popular destination for City workers. It is occupied occasionally by couriers, construction workers and tourists although it is not located near any major tourist attraction in the City. The level of static people is below the sample's mean (27.69) with 9.52 static people recorded throughout the day. Although it is a comparatively low rate, it is still twice the rate recorded for the other two public spaces without catering facilities in the vicinity, viz., St. Anne & St. Agnes churchyard and North Guildhall. Conversely, when we look at static rates for the lunchtime period, Love Lane performs very well with virtually the same number of static people as Fleet Place and New Change/Cheapside Corner. The mean number of static people decreases after 5 pm as it does in all public spaces without catering facilities.

5.2.2.8. New Change/Cheapside Corner

New Change/Cheapside Corner is normally empty until lunchtime, unlike all the other cases, where from 8:00 am there is a small but significant number of people using the space. For the time period of 8:00 to 9:20 am, a mean of 0.50 static people was recorded. For the time period of 9:20 to 11:50, 2.21 static people were recorded, in both cases the lowest numbers of the sample. During the lunchtime period this changes drastically, with high levels of static occupancy. In New Change/Cheapside Corner, a reasonable number of tourists was recorded. In contrast, no office smokers, couriers, or construction workers were documented, which characterises this public space as being used essentially by office workers and occasional tourists probably coming from St. Paul's Cathedral. In addition, a large proportion of the users at Cheapside Corner are basically using the wine bar facilities as illustrated by the mean number of suits not at pubs as 3.02 for the whole day, the smallest number of all cases, including Abchurchyard. This becomes very clear when we look at the ratio of suits at pubs to suits not at pubs. The mean for the sample is 2.17, while for New Change/Cheapside, the ratio is 4.62, the highest of all cases[27].

5.2.2.9. North Guildhall

Unlike Love Lane Corner, which is on the other side of Wood Street, the level of static people inside the public space is comparatively low. The mean number of static people recorded for the whole day is the second lowest for the sample, behind only Abchurchyard. Tourists were recorded in this location, as were construction workers and other casual users. Like New Change/Cheapside Corner, the users do not arrive until later in the morning. For the time slot of 8:00 to 9:20 am, a mean of 0.50 static people was recorded, the same low rate recorded for New Change/Cheapside Corner. For the time slot of 9:20 to 11:50, there is an increase with a mean of 4.17 static people, picking up at lunchtime with 17.40 static people; but North Guildhall remains one of the least used public spaces of the sample as far as the number of static people is concerned.

5.2.2.10. Royal Exchange

Despite the high levels of pedestrian movement through the space, the level of static people is also very high and it seems that both groups are not disturbed by each other. Royal Exchange Square is used by a high number of City workers, many of whom work in traditional institutions like the Bank of England. However, it is a very democratic space since it is also frequented by construction workers, couriers, tourists, and other groups of local workers from the nearby shops. During the summer, it is common to see people sitting on the ground, as the available seats are often not enough to cope with demand. Also, it is one of the public spaces with the highest level of use early in the morning, for coffees or sandwiches from one of the nearby shops. It can be very lively and the mix of people and activities gives this place a nice atmosphere. The mean number of static people recorded was 34.35 throughout the day, the highest of all cases after excluding the two public spaces of the Broadgate Development. After Bank Corner, it is the public space with the highest mean number of tourists and the third for the number of construction workers and couriers. People using the wine bar account for a high percentage of users, although the ratio of suits at

[27] From the eight public spaces with wine bars or pubs in the vicinity, five have an (all day) ratio of pubs users to not pub users between 2.07 and 2.67. The exceptions are Abchurchyard with 0.01, Fenchurch Place with 0.90 and New Change/Cheapside Corner with 4.62.

pubs to suits not at pubs of 2.12 is very close to the sample's ratio of 2.17. In common with all the public spaces with a wine bar, Royal Exchange is well used after 5:00 pm.

5.2.2.11. St. Anne & St. Agnes churchyard

The patterns of static space use for St. Anne & St. Agnes churchyard is similar to the other cases of the sample without wine bars in the vicinity. It is a public space well used during the morning and early afternoon periods, but with low levels of static occupation after 5:00 pm. Like Love Lane Corner or Bank Corner, there is a small increase of static occupation around 5:00 pm due to the "waiting area" effect.

5.2.2.12. Whittington Gardens

Whittington Gardens performs well, like the other public spaces with pubs or wine bars in the vicinity, for the midday and early evening peak. There is also a good balance between the two categories of suits, as the ratio of pub users to non-users is 2.55, close to the sample's ratio of 2.17. Due its location close to the London International Finance Building, the public space is mainly frequented by stockbrokers as seen in Figures C and D, Plate 4.11 in Appendix 2. Similar to Bank Corner and Royal Exchange, a significant number of people use the public space during the morning peak period. The number of tourists recorded in Whittington Gardens is very small, as is the number of construction workers or other occasional users.

5.2.3. COMPARATIVE DESCRIPTION OF LEVELS OF STATIC OCCUPANCY

To produce an overall idea of how all this information is linked together, the collected data during July and August for each public space was compiled into a graph according to the main categories, that is, suits, suits not at pubs and suits at pubs (Plates 5.5 to 5.16 in Appendix 3). The first interesting trend that we can observe from the graphs is how the distribution of the levels of static people inside the different public spaces according to categories is constant, if not identical, throughout the sample[28]. Two representative examples, one public space without pubs (Bank Corner,

[28] Also the graphs illustrate how important it is to collect the data for the different public spaces at exactly the same time. The level of static people changes very abruptly mainly during the midday and afternoon peak times, and a difference of fifteen minutes can give a completely different picture of levels of static occupancy amongst the cases.

Fig. 5.39) and one with (Royal Exchange, Figs. 5.40-5.42) are used to illustrate the findings.

Considering all users (Figs. 5.39 and 5.40) during the time period of 8:30 – 10:30 am, there is an initial increase of static occupation in all public spaces. This is mainly due to the construction workers, but is also due to City workers who take their first coffee break (Figs. 5.39(1) and 5.40(1)). The largest increase in static occupancy is at 1:00 pm (Figs. 5.39(2) and 5.40(2)) when the mean number of static people increases almost ten times compared to pre-lunchtime. It is interesting to compare the research by Burden (1977), who also reports a small increase of people before 9:00 am from his analysis of Greenacre Park in New York, USA. In addition, Burden's graph of static distribution throughout the day (9 am to 7 pm) reveals an almost identical curve to Figure 5.40.

The main difference among the selected cases of the sample stems from the existence, or not, of pubs/wine bars in the vicinity. The spaces without pubs tend to be deserted after 5 pm (Fig. 5.39(3)), in complete contrast to the ones with catering facilities which become "alive" again after 5 pm (Fig. 5.40(4)). In those public spaces, the number of static people at pubs for the time period of 5:00 - 8:00 pm is very close to the lunchtime period (Fig. 5.42(2) and (4))[29]. For the public spaces with pubs, the data showed that for the period of 9:20 to 4:40 pm, pub users account for 49.51% of the total number of suits, a ratio of virtually 1 to 1 for pub and non pub users[30].

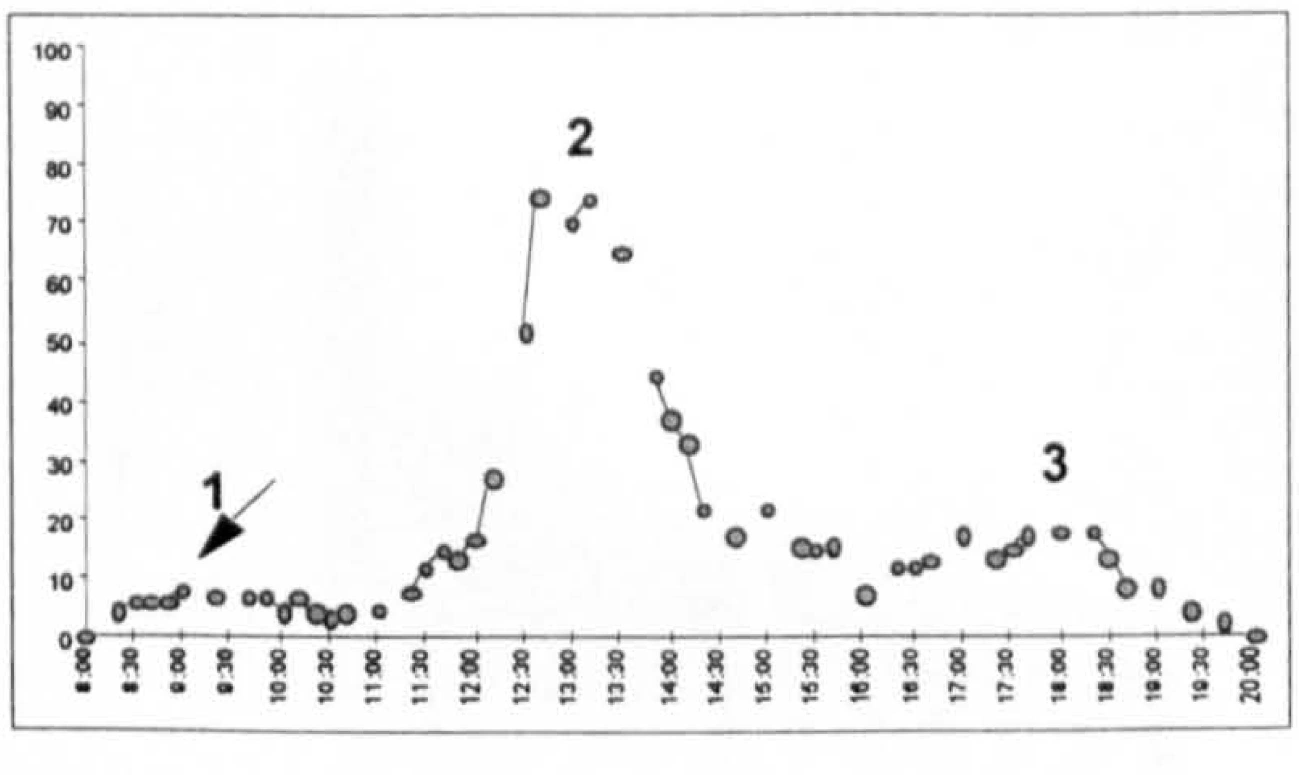

Figure 5.39. Bank Corner: pattern of static people distribution throughout the day – all suits

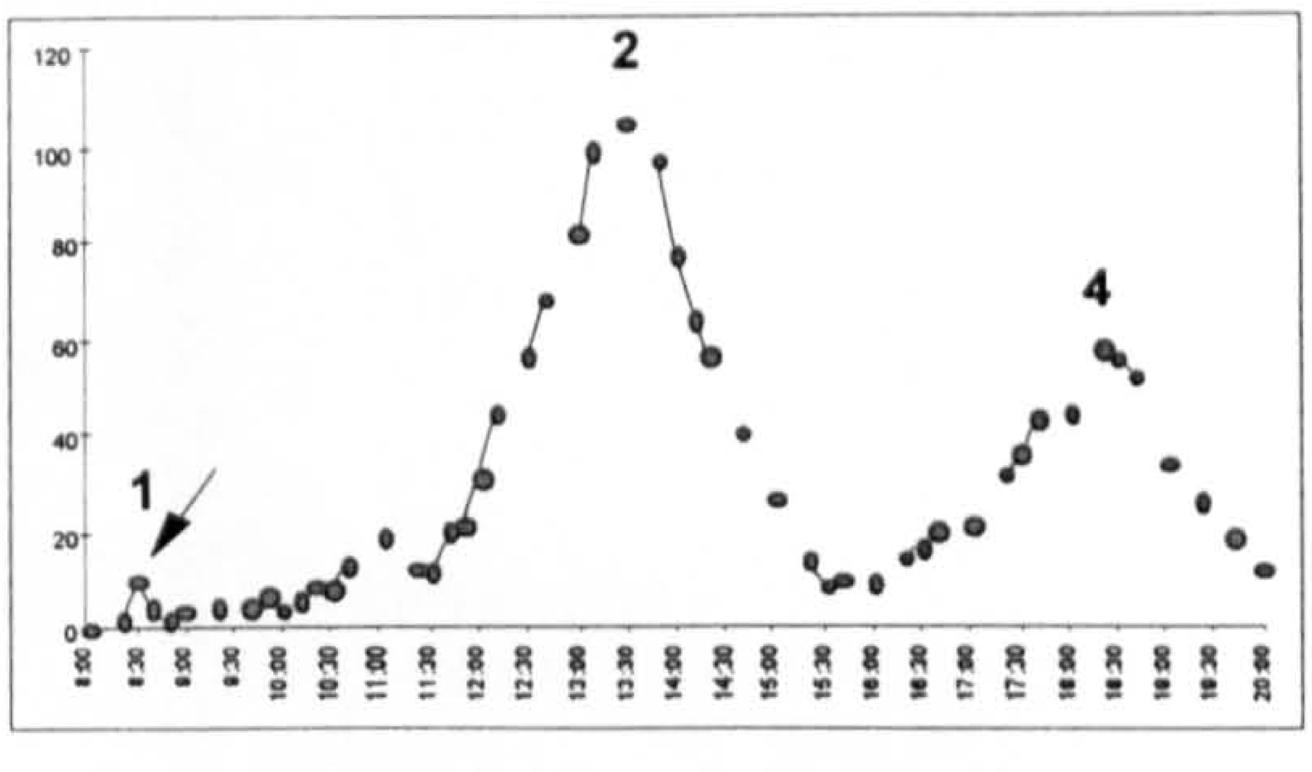

Figure 5.40. Royal Exchange: pattern of static people distribution throughout the day – all suits

[29] The suits at pubs category are generally recorded after 10:00 am, when the pubs and wine bars open.

[30] From the data on static occupancy, a mean number of 10263 suits was divided into 5182.50 for non pub users and 5070.50 for pub users, using the data for the public spaces with pubs or wine bars only.

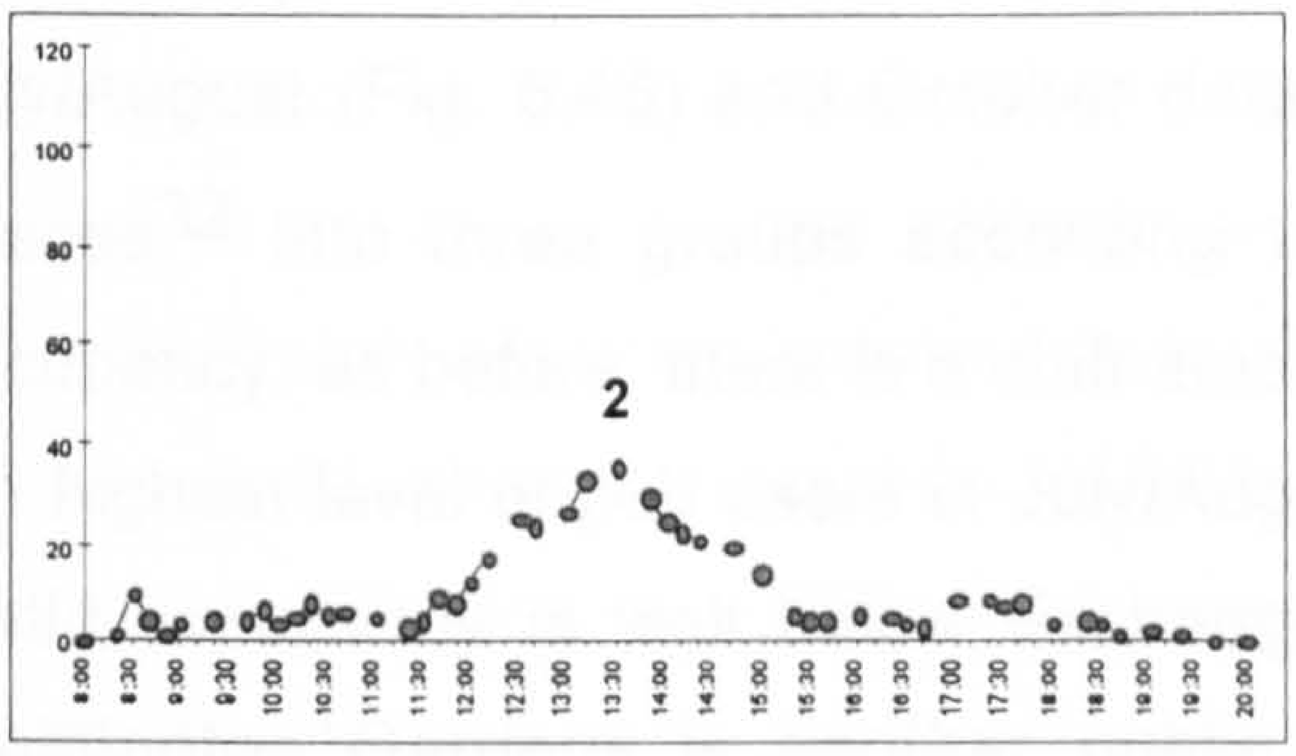

Figure 5.41. Royal Exchange: pattern of static people distribution throughout the day – suits not at pubs/wine bars

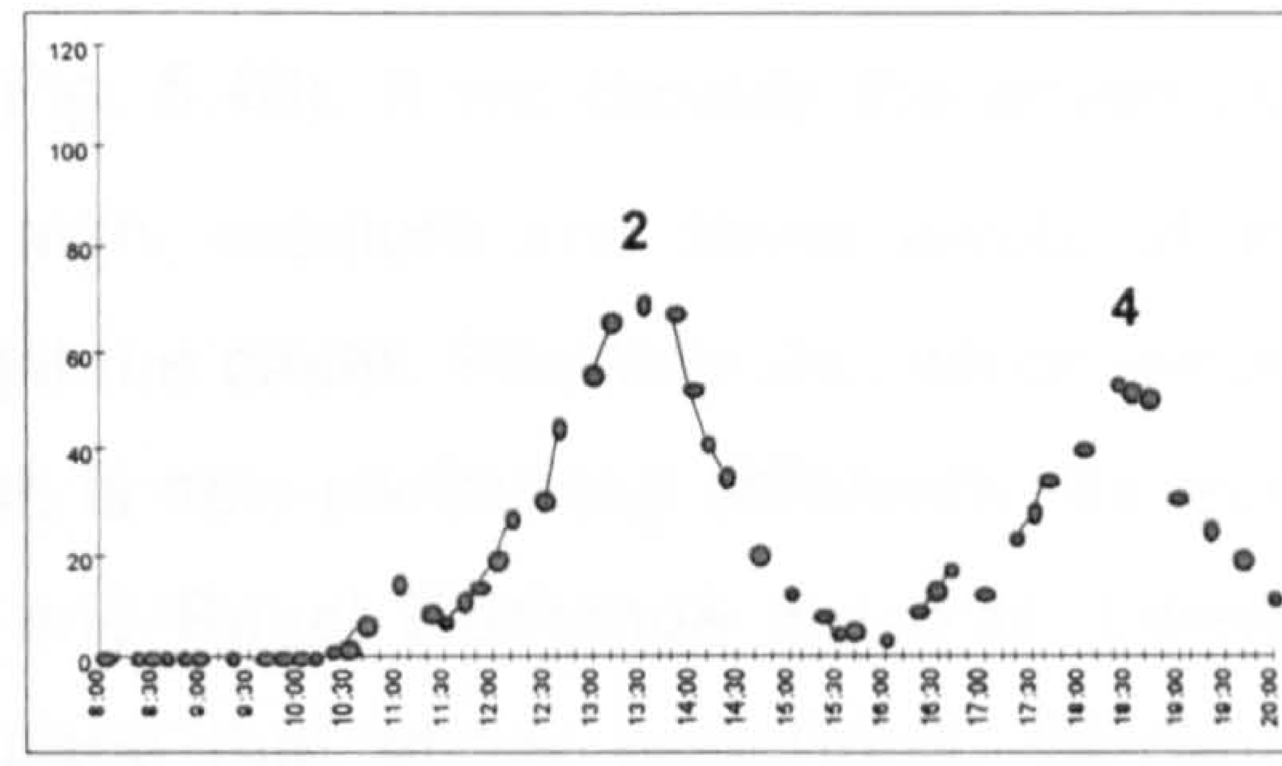

Figure 5.42. Royal Exchange: pattern of static people distribution throughout the day – suits at pubs/wine bars

When comparing the levels of static occupancy for the twelve cases, a consistent pattern can be observed for the July/August and October data (although numerically there is a significant difference between the two periods). The public spaces were coloured dark, medium or light grey according to three levels of static occupancy. Figure 5.43 illustrates the levels of static occupancy for the twelve cases for the summer data (July and August). Subsequently each public space was coloured following the same pattern for the autumn data (October), seen in Figure 5.44, with the number of suits not at pubs (lunchtime only)[31] printed on the top of each column.

The data shows that the performance of public spaces is unchanged in both seasons. The public spaces that had the highest number of people in July also recorded the highest number of people in October, and the same is valid for the spaces at the other end of the spectrum.

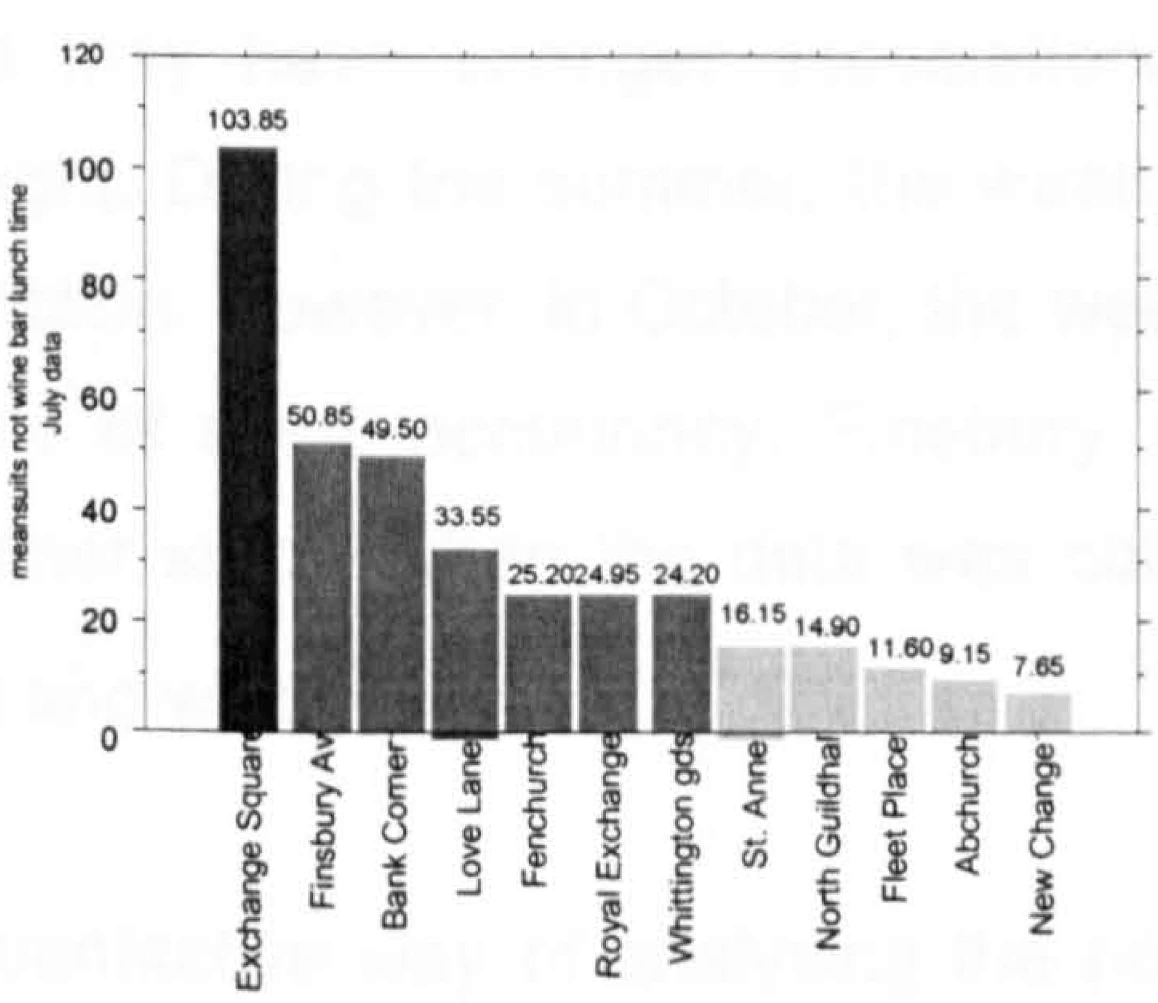

Figure 5.43. Frequency distribution of static people not at pubs during July / August – lunchtime

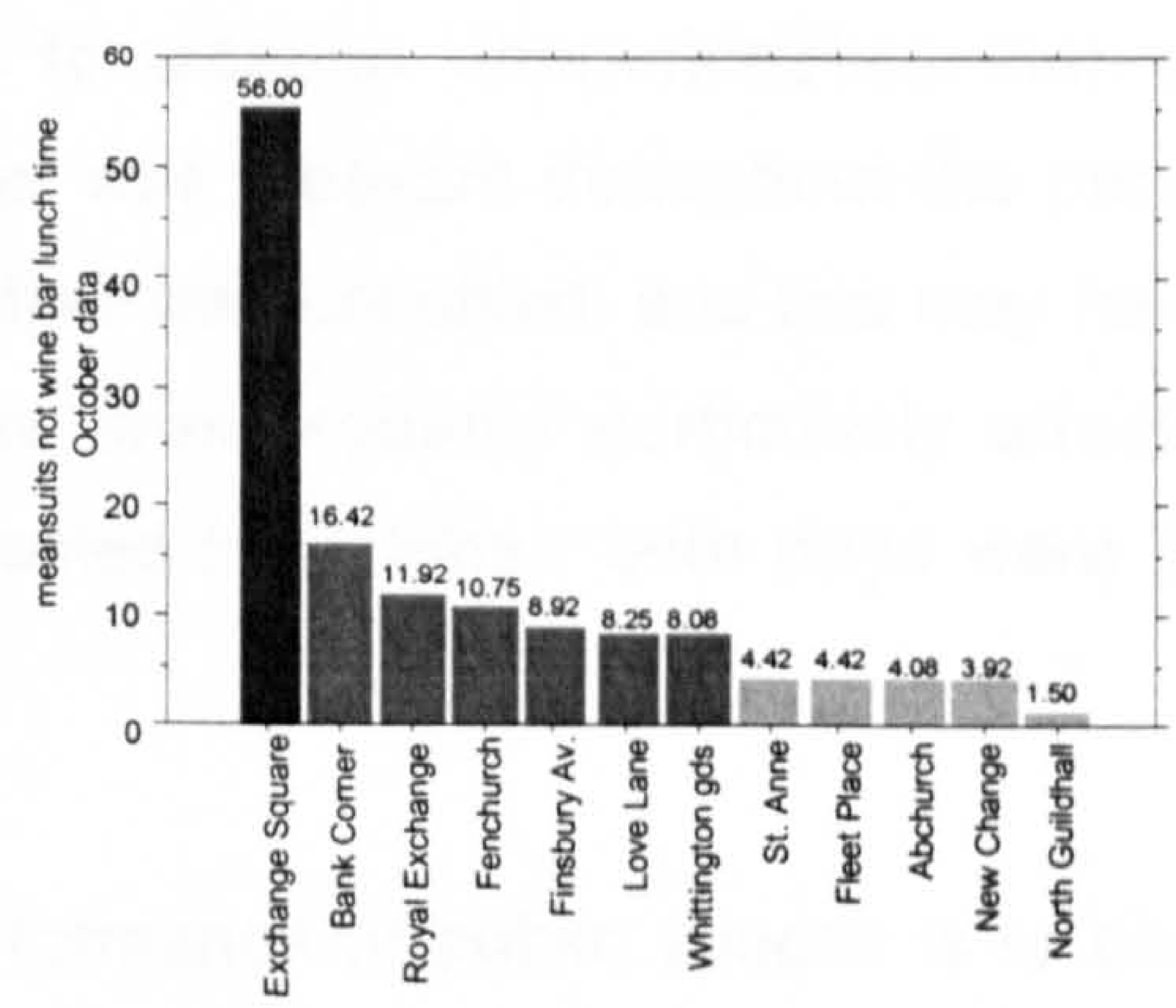

Figure 5.44. Frequency distribution of static people not at pubs during October – lunchtime

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31 The data is compared for the lunchtime period because in October the data was collected only for that time period.

Conversely, for pub users, the pattern is not so consistent when comparing July/August (Fig. 5.45) and October data (Fig. 5.46). If we classify the seven public spaces[32] into three groups according to high, medium and lower levels of static occupancy, as before, there is a shift amongst the cases. Finsbury Av., which recorded the highest level of pub users in July/August, is now performing differently. Its level of static occupancy is well below Exchange and Royal Exchange Squares. Likewise, Whittington Gardens is another public space that under performed. Whittington Gardens recorded similar rates of pub users in July/August compared to Royal Exchange. In October, Whittington Gardens recorded almost four times less people than Royal Exchange.

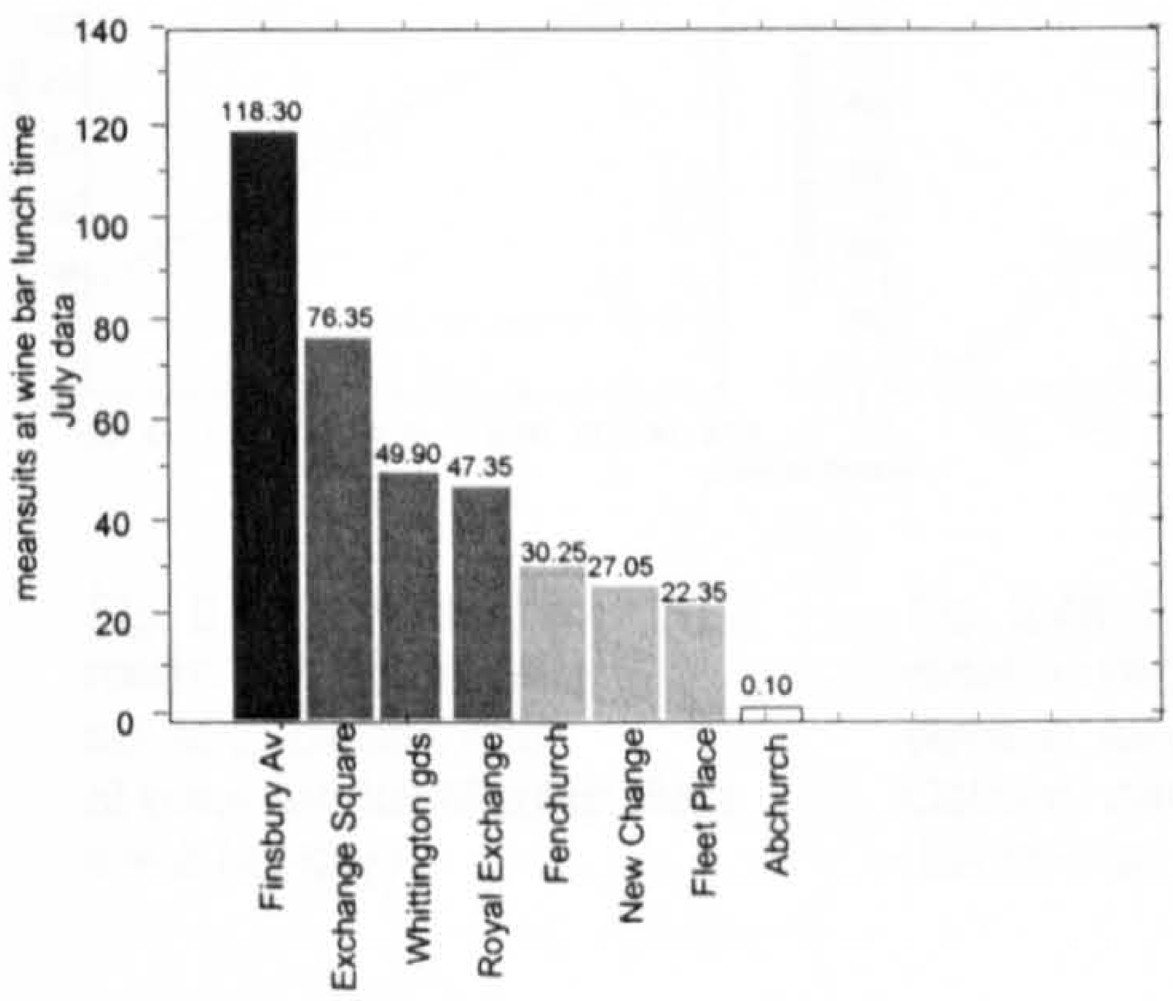

Figure 5.45. Frequency distribution of static people at pubs during July / August – lunchtime

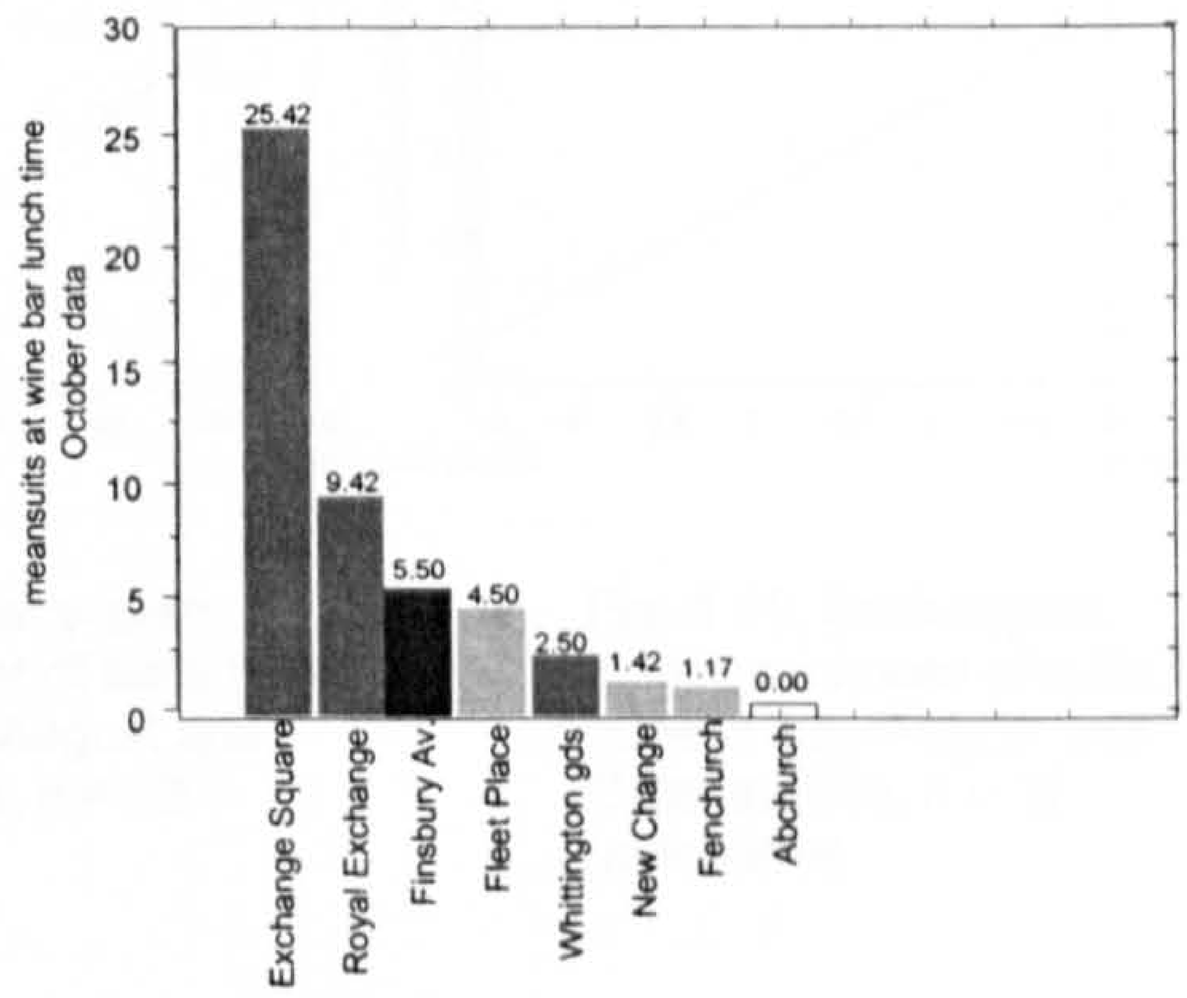

Figure 5.46. Frequency distribution of static people at pubs during October – lunchtime

An explanation for this variation in the number of suits at pubs during summer and autumn periods may be related to the use of such facilities. The use of pubs or wine bars may have stronger associations to weather characteristics than previously thought. During the summer, the weather was pleasant throughout the period of data collection. However, in October, the weather was unsettled, and this may have affected levels of static occupancy. Finsbury Av. was probably particularly affected by the weather since, when the data was collected in October, both days were particularly cold and windy[33].

A quantitative way of analysing the performance of public spaces is to correlate the number of users according to categories and according to months of the year. For

[32] Abchurchyard was not coloured because, as described previously, only one person was observed using the facilities of the wine bar inside the public space over two days of observations, making it statistically an insignificant number.

[33] Plates 5.5 to 5.16 (Appendix 3) give information on the mean temperature and weather outlook for each day of field work.

July/August (Fig. 5.47), the scattergram shows that the mean number of suits not at pubs increases in the same proportion as suits at pubs. Similarly, when the investigation focused on the relation between suits not at pubs for different months (Fig. 5.48), a linear correlation was also found. Thus, the number of suits not at pubs increases in the same proportion for both July/August and October. Because of the not uniform distribution of points along the regression line with the point representing Exchange Square (top right point) at one end and a cluster of points at the opposite side, the data was normalised (natural log - ln) for both variables (Fig. 5.49). The results confirm a linear correlation.

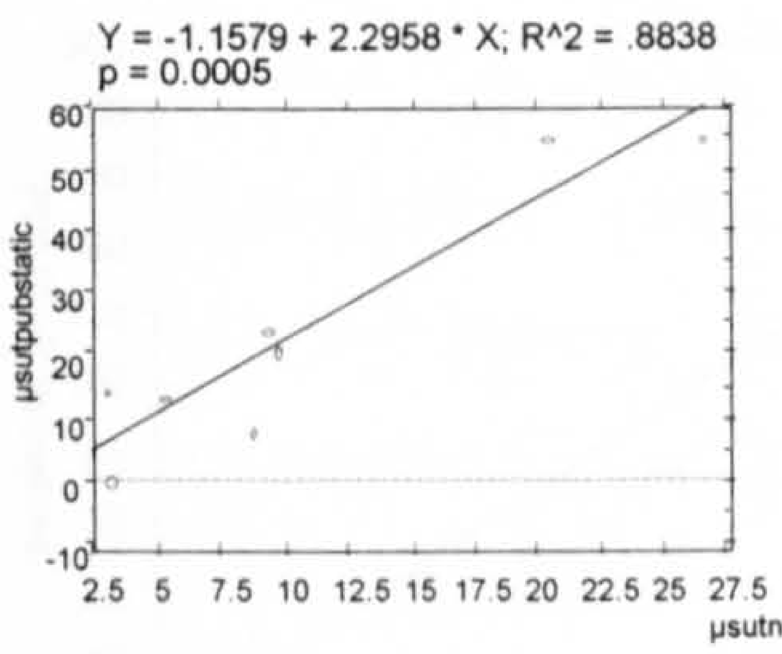

Fig. 5.47. Scattergram mean number of suits not at pubs and suits at pubs for July/August data, n = 8 (all day)

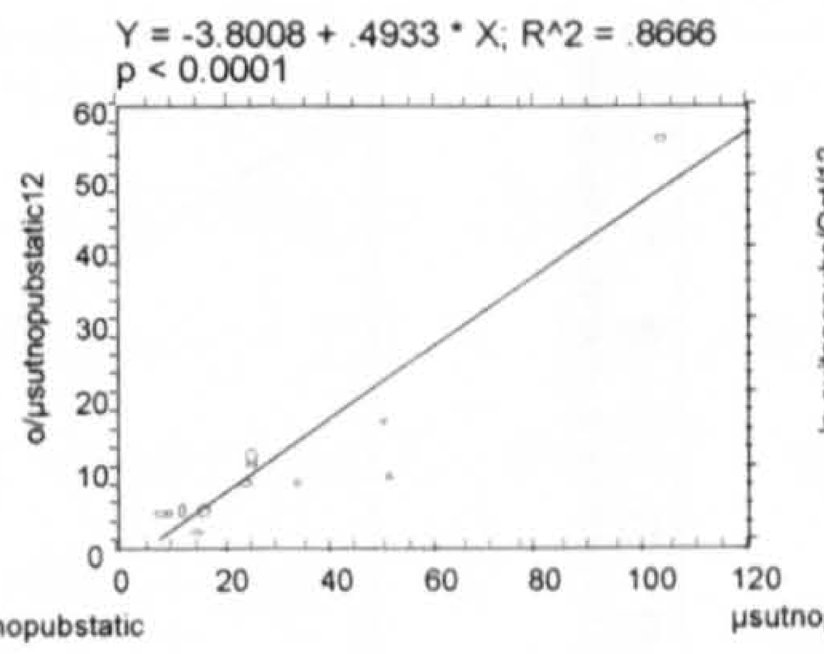

Fig. 5.48. Scattergram mean number of suits not at pubs in July/August and October data, n = 12 (lunchtime)

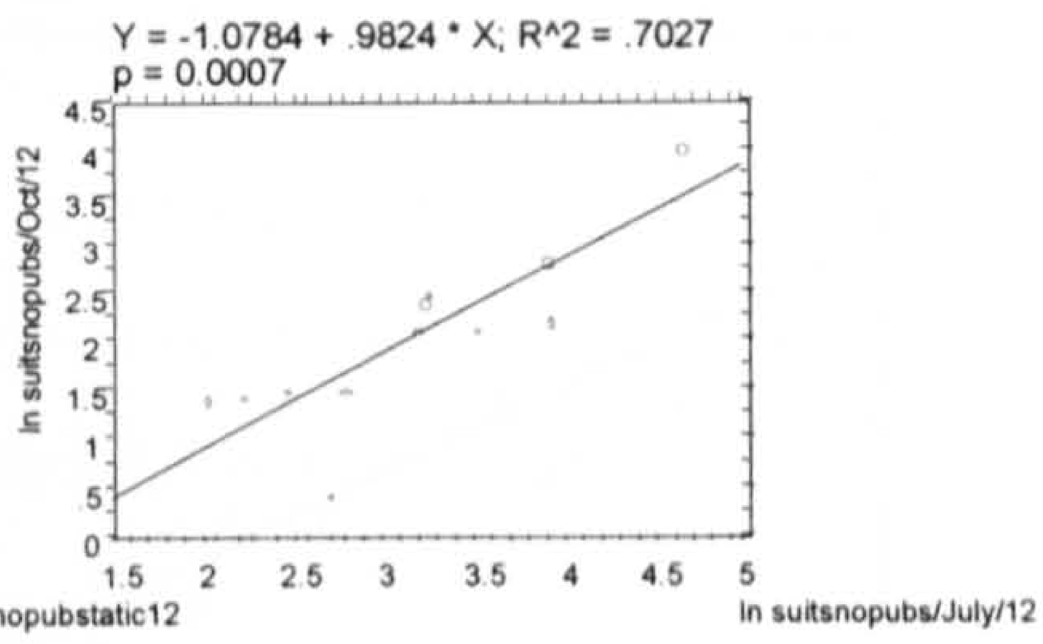

Fig. 5.49. Scattergram ln mean number of suits not at pubs in July/August and October data, n = 12 (lunchtime)

These results can be compared with another interesting study by Chidister (1986). From his study of five public squares in Minneapolis, Chidister claims that there are two important measures concerning public space use, that is, the "mean use" and "mean density use"[34]. He found that the public spaces with the highest amount of people in fact had the lowest density of use and he concludes, "Larger plazas...were not used as efficiently as the smaller ones" (Chidister, op.cit., p120). For the public squares of Minneapolis, he found a mean static density of 0.01. Whyte found a mean static density of 0.035 for the public squares of Manhattan (after Chidister, 1986, p117). The mean density of static people for the public spaces in the City of London is between the two with 0.017 (from 8 am to 4:40 pm).

However, contrary to Chidister's (1986) study, the analysis of the density of static people for the public spaces in the City of London did not reveal either a positive or negative correlation between the number of users and the size of public spaces. Exchange Square, which is the largest public space of the sample, indeed has a low

[34] "Mean use" is defined by the mean number of static people observed, whereas the "mean density use" is the mean number of static people divided by the public space area.

density of use. Conversely, Finsbury Av., the second largest space, has one of the highest densities of use as seen from Table 5.6 (next page). In addition, the data showed that the users' profile is constant throughout the day. The public space that recorded the highest number of static people during lunchtime also recorded the highest number for off peak hours[35] as seen in Figure 5.50. Therefore, the density of static use for both periods is also unchanged and does not present diurnal patterns amongst public spaces (Fig. 5.51). Larger spaces can be as "efficient" as smaller ones.

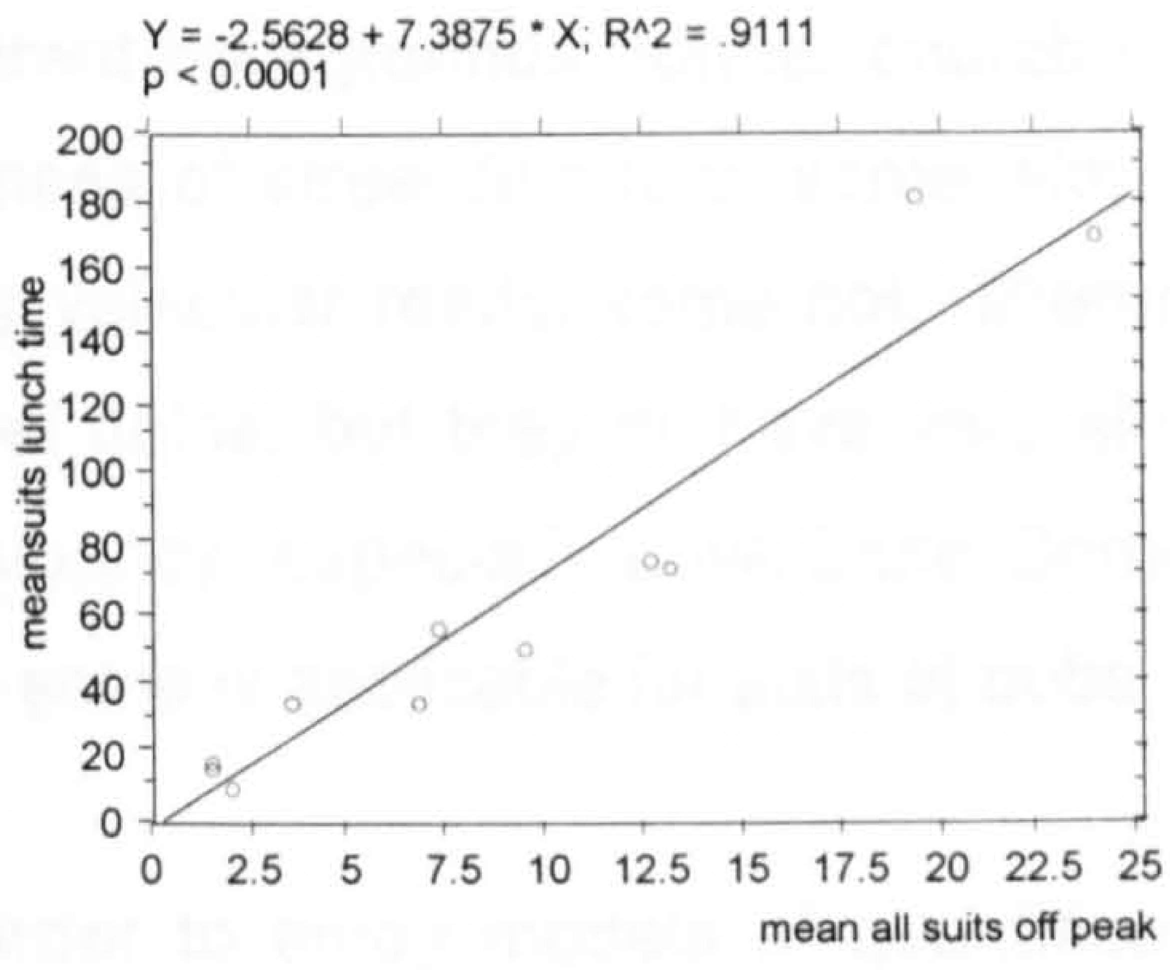

Fig. 5.50. Scattergram mean number of suits off peak period and lunchtime period

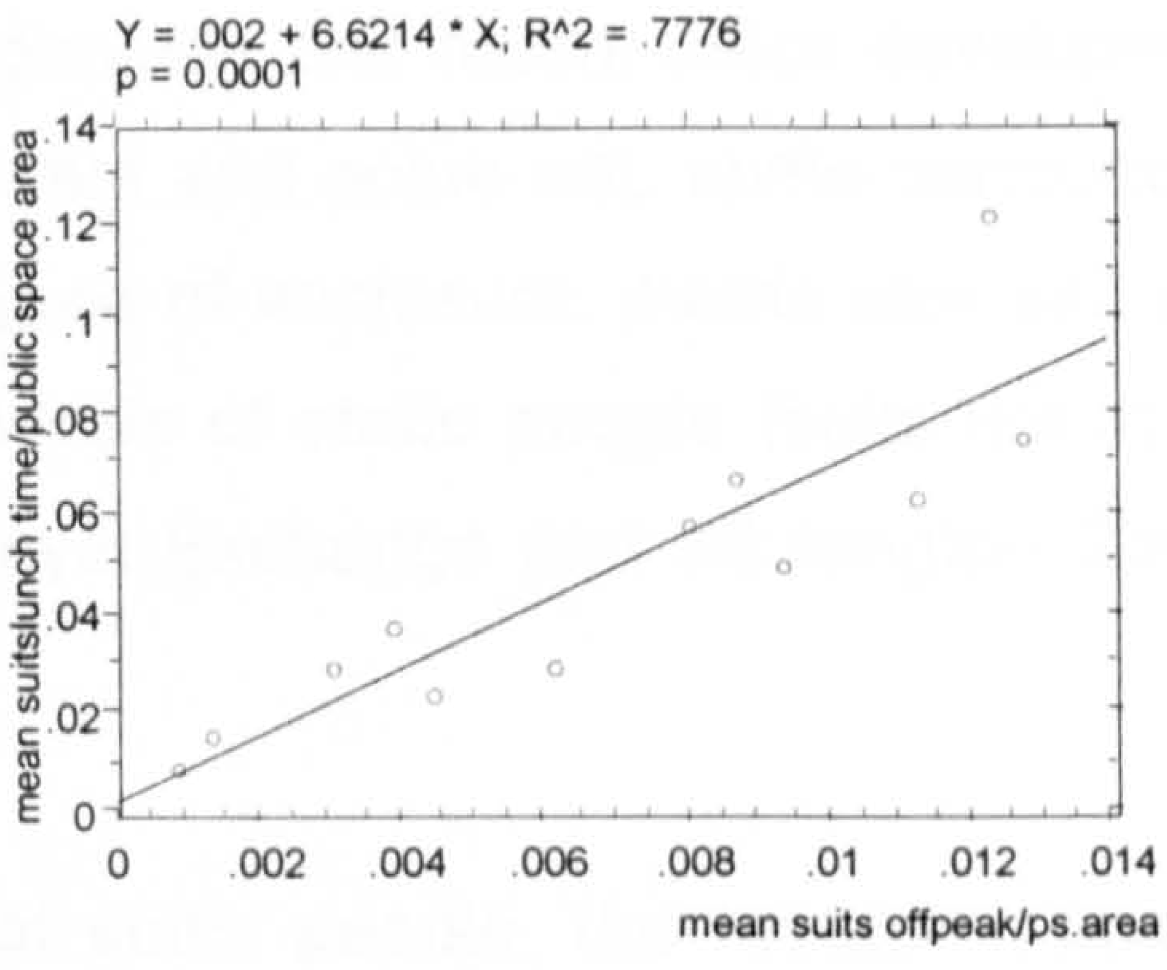

Fig. 5.51. Scattergram density of suits off peak period and lunchtime period

In addition, density, or the number of static people in relation to the size of the public space can vary tremendously throughout the day for the same public space without detriment to its performance. For instance, for Finsbury Av., there was a variation between 1 and 449 static people recorded at different times for the same day. Although there have been some attempts to suggest the ideal size for public spaces according to the likely number of users (Alexander et al., 1977), this research suggests that there is no ideal density. In addition, it is suggested that density is not an effective parameter for evaluating the performance of public spaces.

[35] Static occupancy for the off-peak period was quantified by the mean number of static people between 8:00 – 9:20 am (early morning peak), 9:40 and 11:50 am (mid-morning period) and 2:20 – 4:40 pm (mid-afternoon period).

5.2.4. LEVELS OF STATIC OCCUPANCY AND THE CONVEX AND ISOVISTS PROPERTIES

The results of previous analysis have illustrated that public spaces do present a constant performance throughout the day, also according to type of users and months of the year. The analysis also suggests that public spaces with different spatial characteristics follow similar patterns of static occupancy. As an example, in Figures 5.43 and 5.44, the intermediate group (from Finsbury Av. to Whittington Gardens) is very heterogeneous as far as spatial characteristics are concerned. They have different backgrounds (former church burial grounds and recent office developments), richness of street furniture, some with wine bars and some not, some surrounded by busy vehicular roads, some not, different degree of enclosure, metric size and size of visual fields, but they all have very similar levels of static people (suits not at pubs) occupancy, especially Love Lane Corner, Royal Exchange and Whittington Gardens. The same is applicable for suits at pubs.

In order to study models of quantification of static people, the research, based on space syntax methodology, examines a series of morphological properties (previously identified in Chapter 4) which might be associated with the performance of public spaces. This research starts by investigating whether there is an association between the number of static people and the area of public spaces, isovists and enclosure ratio. Table 5.6 gives a summary of the spatial data used for this analysis. For the levels of static occupancy, refer to Tables 5.4 and 5.5 (Section 5.2.1).

Public space name	Public space area (m^2)	Isovist area (m^2)	Enclosure ratio	Users density[36]
Abchurch yard	322.99	1024.66	2.82	.012
Bank Corner	1019.85	17951.07	0.59	.019
Exchange Square	6371.41	8114.85	3.37	.010
Fenchurch Street	830.98	3595.39	0.22	.024
Finsbury Av.	2957.79	14331.85	3.34	.021
Fleet Place	1493.24	7459.59	2.82	.009
Love Lane Corner	918.74	7419.72	1.16	.012
New Change	288.61	22541.51	0	.040
North Guildhall	1666.82	7144.56	3.18	.003
Royal Exchange	1170.33	12157.95	2.56	.024
St.Anne St.Agnes	1095.90	9213.54	0.61	.005
Whittington Gds.	984.30	19263.00	0.13	.029
MEAN ALL CASES	1593.41	10851.47	1.73	0.017

Table 5.6. Spatial elements for the 12 selected public spaces

[36] Users density is defined by the ratio between the mean number of suits and the area of the public space (8 am to 4:40 pm).

For the study, the mean number of suits (previous analysis has shown that the suits not at pubs and suits at pubs categories have the same numerical profile throughout the day) for the first four time periods[37], is examined against three public space characteristics: public space area, convex isovist area, and the enclosure ratio, with the data collected in July/August. The reason for limiting the data to 8 am to 4:40 pm is because the public spaces with and without wine bars will have, as previously discussed, incomparable levels of static occupancy after 4:50 pm.

Figure 5.52, which shows the scattergram for the mean number of suits against the area of the public spaces, initially indicates a positive linear correlation. However, the distribution of the data in the scattergram suggests that this result may be a fortunate outcome of the two top-right points (representing Exchange Square and Finsbury Av.) and requires further investigation. The non-parametric Kendal rank correlation test was applied[38], leading to the conclusion that there is not an association between the two variables. When considering the convex isovist areas no correlation between the variables was found either (Fig. 5.53)[39]. Finally, the scattergram (Fig. 5.54) shows two distinctive groups with independent levels of static occupancy as far as the enclosure ratio is concerned.

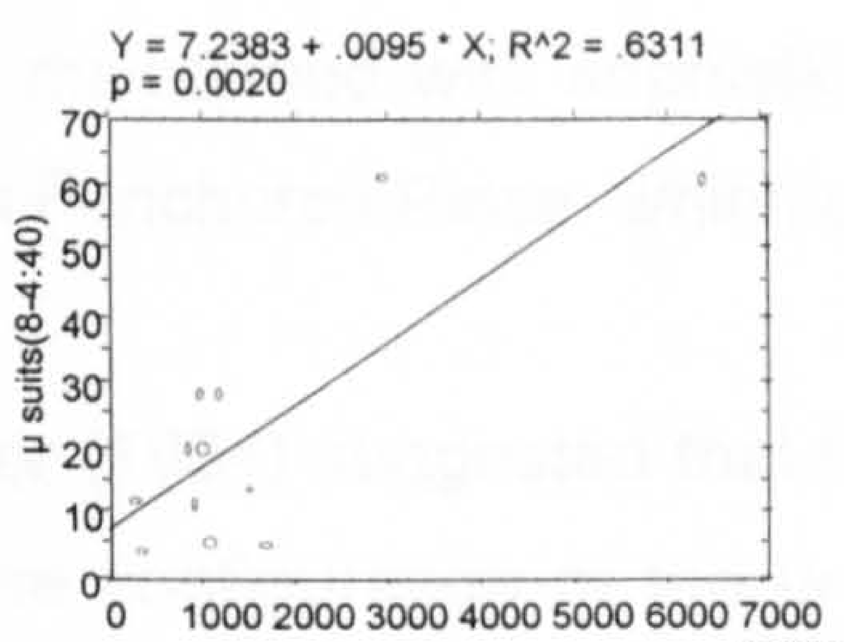

Fig. 5.52. Scattergram public space area and the mean number of suits (8 am-4:40 pm)

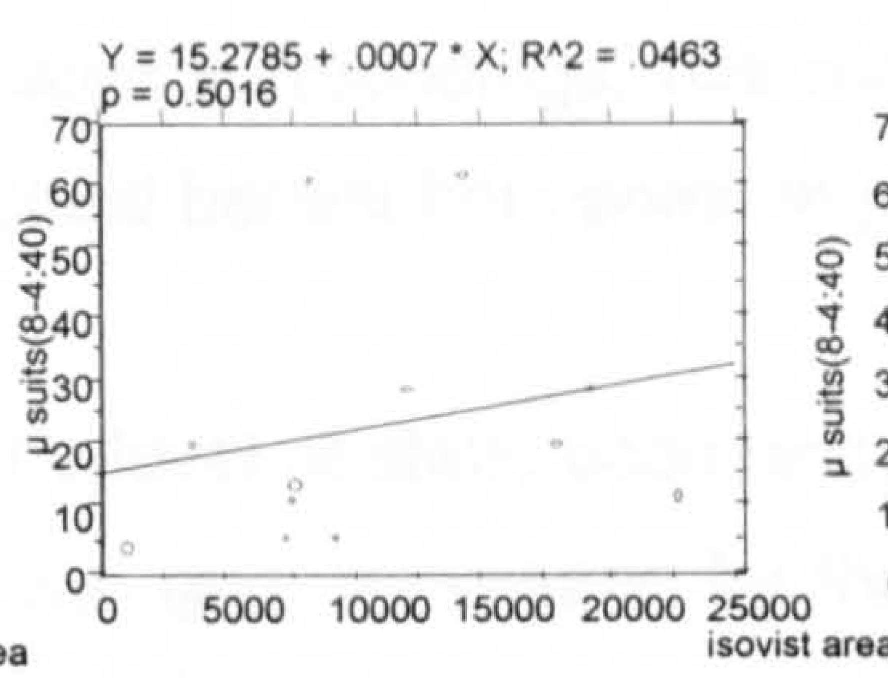

Fig. 5.53. Scattergram isovist area and the mean number of suits (8 am-4:40 pm)

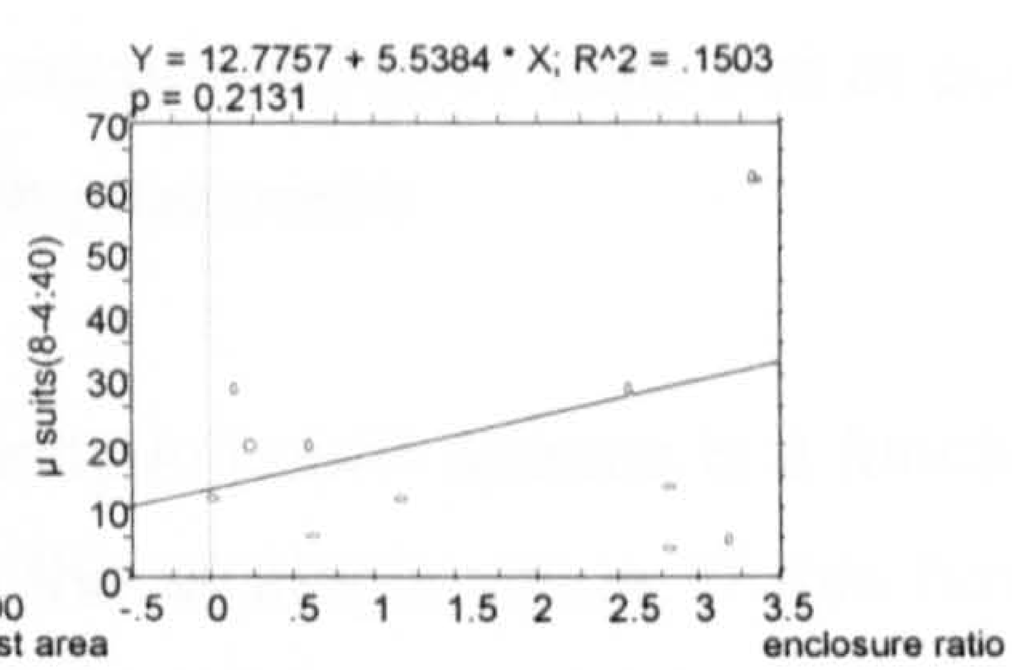

Fig. 5.54. Scattergram enclosure ratio and the mean number of suits (8 am-4:40 pm)

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37 The time periods are: 8:00 - 9:20 am (early morning peak), 9:40 - 11:50 am (mid-morning period), 12:00 - 2:10 pm (midday peak) and 2:20 - 4:40 pm (mid-afternoon period).

38 The results are: Tau corrected for ties = 0.3333 with p = 0.1314. The data was also tested as to whether there was a logarithmic or square-route relationship, but with negative results.

39 The correlation between the sum of the length of isovists and number of suits (8 am to 4:40 pm) for the three measurements methods as described in Chapter 4 showed in all accounts that both variables are independent of each other. The results are: Isovist total: R-squared = 0.0582 and p= 0.4499. Isovist selected: R-squared = 0.1352 and p = 0.2397. Isovist special: R-squared = 0.1066 and p = 0.3002. It was also assessed the correlation between the mean of isovists' lengths and number of suits for the three measurements methods. Again, in all accounts, the scattergrams showed that both variables are independent of each other. The results are: Isovist total: R-squared = 0.0733 and p = 0.3947. Isovist selected: R-squared = 0.0275 and p = 0.6063. Isovist special: R-squared = 0.0096 and p = 0.7619. Likewise, no relationship was found between the mean number of suits (8 am to 4:40 pm) and the visibility ratio: R-squared = 0.0384 and p = 0.5415. Also refer to Table 5.8 - correlation matrix in Appendix 3.

In summary, the analysis shows that the number of static people is not associated to any of these properties. Enclosure, which has often been positively associated with the presence of static people in public spaces also showed to be an inconsistent variable, with enclosed and exposed spaces having similar levels of static occupancy[40]. These findings are consistent with Chidister's study (1986) on the effect of the context on the static occupancy of a group of public spaces in Minneapolis, he acknowledges that "variation in design has accounted for only a small amount of the variation in use" (Chidister, op.cit., p115).

With such a diversity of elements, one main question arises. Is it possible, after all, to predict levels of static occupancy for public spaces? Do wine bars or any kind of retail activity guarantee the presence of static people? Apparently not. Bank Corner and Finsbury Av. have virtually the same number of suits not at pubs and they could not be more different according to the parameters just discussed. In fact, Bank Corner registered more "suits" all day during the summer and autumn than Fleet Place and New Change, both with wine bars facing the public space[41]. If we restrict the analysis to public spaces with wine bars, Finsbury Av. with only one wine bar performs better, as far as the number of users is concerned, than Exchange Square with three. If we look at richness of street furniture, Fleet Place, which is a very well designed space, well maintained with sophisticated surroundings, has recorded fewer suits not at pubs than Fenchurch Place, which could benefit from some improvement.

Hillier (1984) suggested that the level of static occupancy in public spaces is a function of the configuration of the urban grid, expressed by the strategic value. If this holds true for the selected cases, then it will be possible to establish a model for predicting the number of static people. In the next section, the question of whether levels of static occupancy are a result of the morphological properties of the urban grid in which public spaces are embedded will be analysed.

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40 Refer to discussion in Section 4.5.1.2, Chapter 4.

41 Refer to Table 5.4, Section 5.2.1.

In summary, at this stage the analysis on static occupation has showed that:

- Levels of static occupancy for summer and autumn periods follow the same trend.
- Large public spaces can be as efficient as small ones as far as density of use is concerned.
- The mean number of static people (suits) is independent of the area of the public spaces.
- The mean number of static people (suits) is independent of the convex isovist areas and lengths.
- The mean number of static people (suits) is independent of the enclosure ratio.

5.2.5. AXIAL BREAK-UP MODELS, SOME CONSIDERATIONS

Before proceeding with the analysis of configuration properties of the urban grid and number of static people, some questions are raised specifically regarding the axial break-up modelling of public spaces in the context of the urban grid. In Chapter 4, public spaces were modelled with the fewest and longest axial lines that would link all convex spaces. It was called the "basic model" and it was applied for the morphological analysis of the public spaces in the City of London. As discussed at the beginning of this chapter, this previous model did not account for some important pedestrian routes, although all convex spaces had been linked. A new model was proposed and it was named the "effective routes model", using the fewest and longest axial lines covering all significant pedestrian routes (refer to Section 5.1.3).

A third experimental model is proposed. It aims to evaluate whether a public space that can be seen from a multiplicity of directions, mainly the ones with extensive peripheral isovists (refer Section 4.4.2.1, Chapter 4) could in principle be more connected to the City workers' daily routes compared to those with small number of isovist branches. Royal Exchange is used as an example (Fig. 5.55). The vertical axial line from Change Alley (A) to Bartholomew Lane (B) links the public space with the adjacent linear spaces (Cornhill and Threadneedle). However, for people moving northwards by Birchin Lane (C), just before reaching Cornhill, Royal Exchange becomes visible and therefore has the potential to work as a transitional space between destinations. Therefore, from each vertex of the isovist branches, an axial line was drawn and the new axial map was re-processed. This model is called the "visibility model".

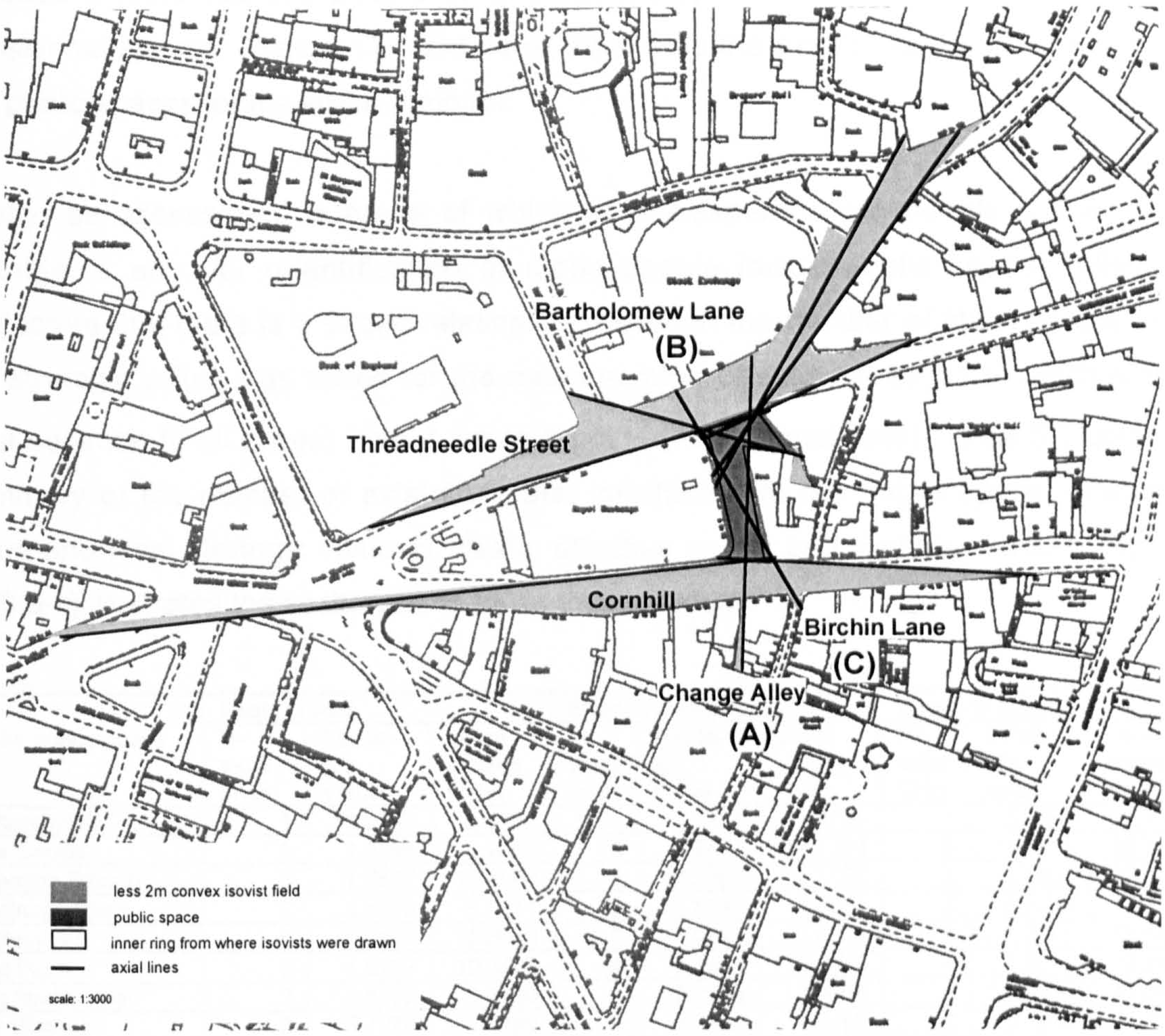

Fig. 5.55. Example of visibility break-up model for Royal Exchange

The principal factor when constructing this model is, not how far can we seen from within the public space, but how far the observer can see and recognise the public space as a transitional space and therefore incorporate it in his route between destinations. Because convex isovists are drawn from all points within the public space, there will be some locations (mainly the peripheral isovists) where the observer will see theoretically just "one point" of the public space. It is very likely that he will not be able to distinguish this "point" as part of a public space or rather than a building entrance for instance. A small exploratory field study was carried out and it was concluded that an observer needed to see at least two metres inside the public space in order to acknowledge this information. Consequently, instead of constructing convex isovists fields from all the points within the public space (as done in all previous analysis), isovists were drawn from a two metre-inner ring around the perimeter of the public space (Fig. 5.55). In practical terms, only the peripheral isovist branches will be shorter. The number of axial lines will be the same, but with fewer connections and therefore probably with smaller global and local integration values. However this may produce a more realistic picture of when public spaces are perceived as potential transitional spaces. Plate 5.17, next page, illustrates the axial lines that interface with the public spaces for the visibility model.

Firstly, as assessment is made of which of the experimental models is the most suitable, if any, for quantification of static people inside public spaces. Hillier's conjecture that there is a strong relationship between the number of static people and the strategic value, was tested for the mean number of suits not at pubs (which is the data common to all cases) from 8 am to 8 pm[42] (July/August data). Table 5.7 gives a summary of the number of axial lines that interface with the public space, strategic value and local strategic value for basic, effective routes and visibility models. Figure 5.56(a-c) illustrates the scattergrams for all three models.

	Basic model			Effective routes model			Visibility model		
Public space name	N• axial lines	Strate-gic value	Local strateg value	N• axial lines	Strate-gic value	Local strateg value	N• axial lines	Strate-gic value	Local strateg value
Abchurchyard	1	1.2742	1.4784	1	1.2754	1.4784	3	3.8766	7.1568
Bank Corner	2	2.9486	8.9349	3	4.3414	12.1316	8	11.7780	38.7075
Exchange Square	6	7.0892	19.2680	7	8.2563	23.2178	8	9.4852	27.3185
Fenchurch Place	2	2.4320	5.9271	3	3.6946	9.8557	5	6.1431	17.7488
Finsbury Av.	5	6.0197	15.5890	6	7.2343	19.4871	6	7.2675	19.5465
Fleet Place	3	4.0783	10.3940	4	5.3400	13.8070	6	7.8818	18.7940
Love lane Corner	2	2.5132	6.2390	3	3.7073	8.9694	3	3.7224	11.0182
New Change	2	2.7220	7.8169	2	2.7246	7.8169	6	8.7690	29.4718
North Guildhall	2	2.4441	5.5537	2	2.4465	5.8311	8	9.5455	25.4704
Royal Exchange	3	4.1341	10.9140	3	4.1382	11.0755	9	12.5376	38.7991
St. Anne & St. Agnes	2	2.6782	7.4439	2	2.6808	7.4439	6	7.8672	23.3619
Whittington Gardens	1	1.3869	3.9368	3	4.0107	11.1947	6	8.1089	25.0629

Table 5.7. Syntactic values according to experimental axial break-up models

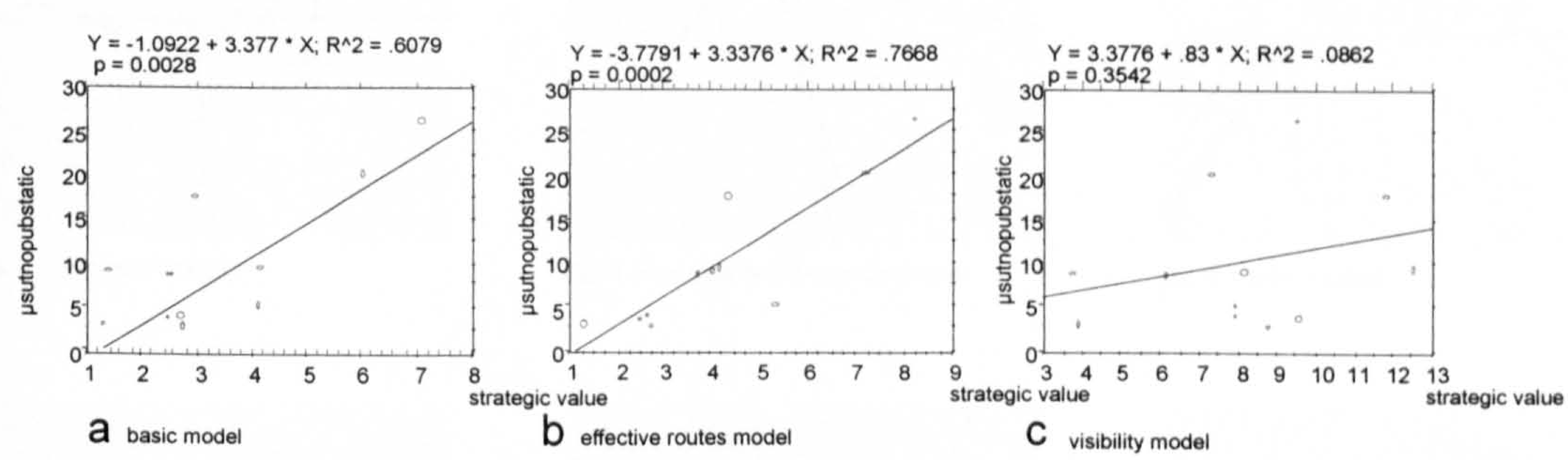

Figure 5.56. Scattergrams for sum of static people and strategic value for three experimental break-up models

42 For the complete data on static people, refer to Plates 5.5 to 5.16 in Appendix 3.

Plate 5.17. City of London public spaces: visibility axial break-up model

scale: 1:3500

interfacing axial lines
remaining axial lines
effective space

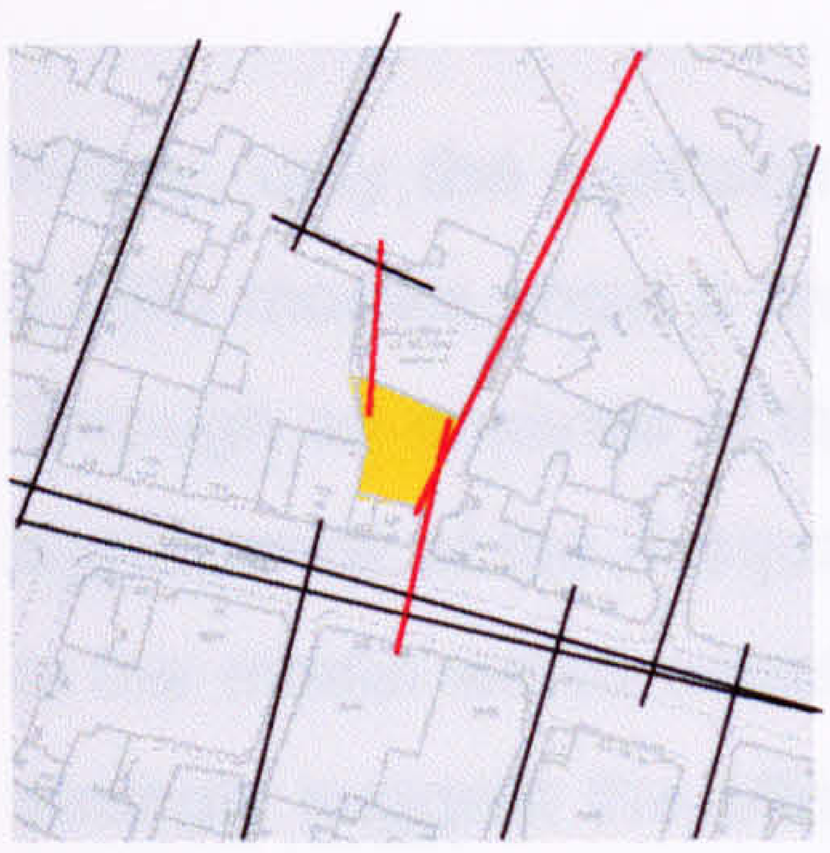

Fig. 1. Abchurchyard

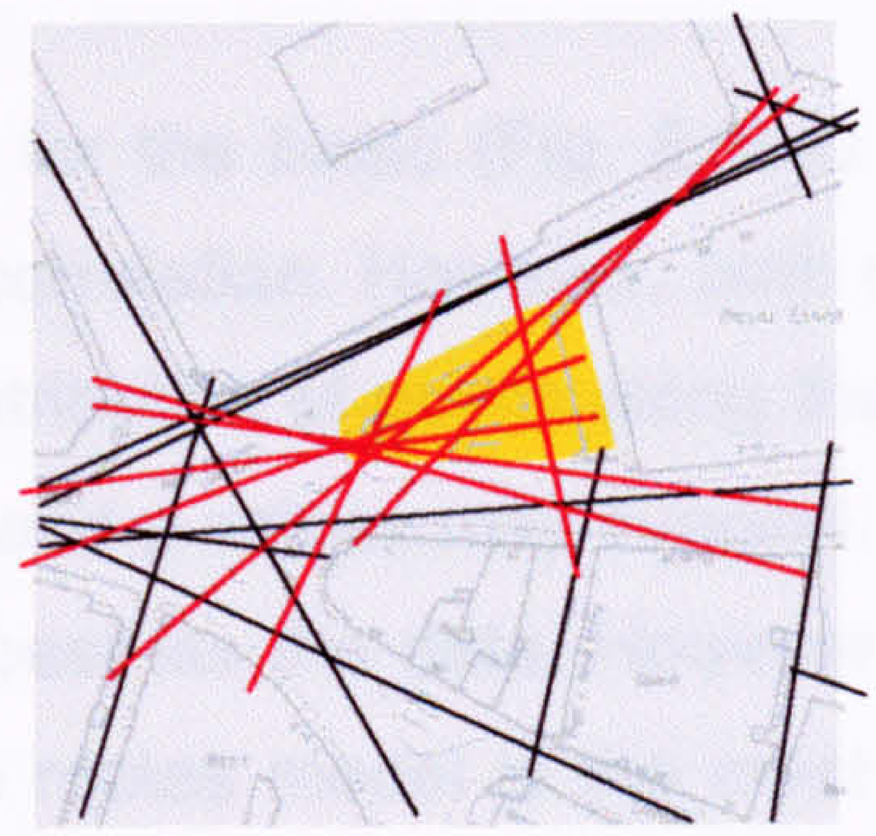

Fig. 2. Bank Corner

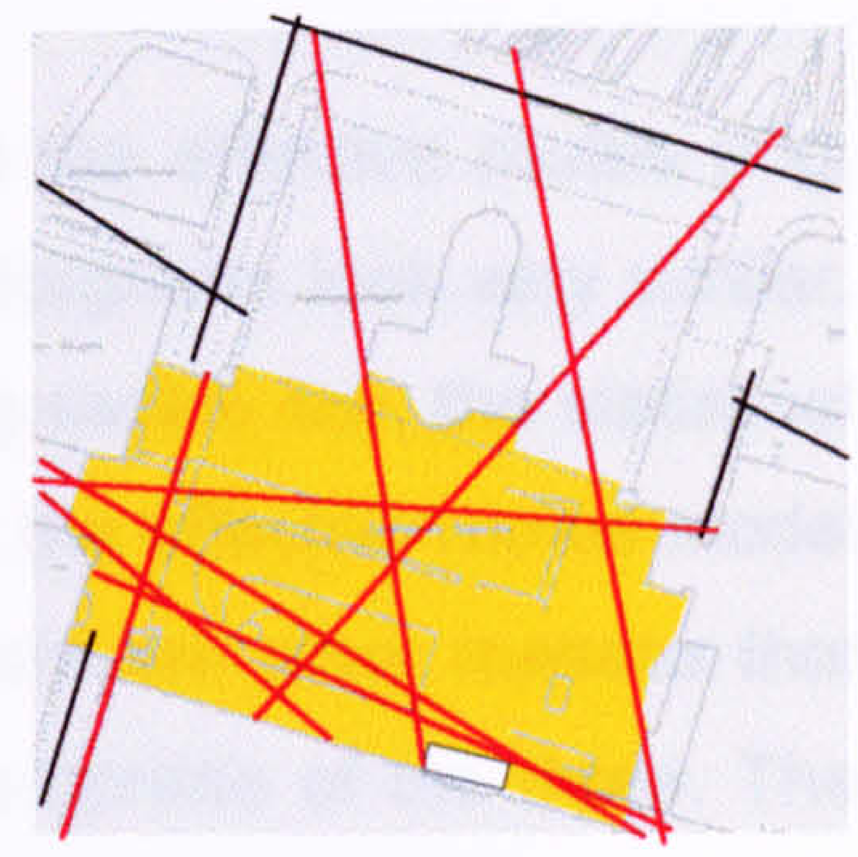

Fig. 3. Exchange Square

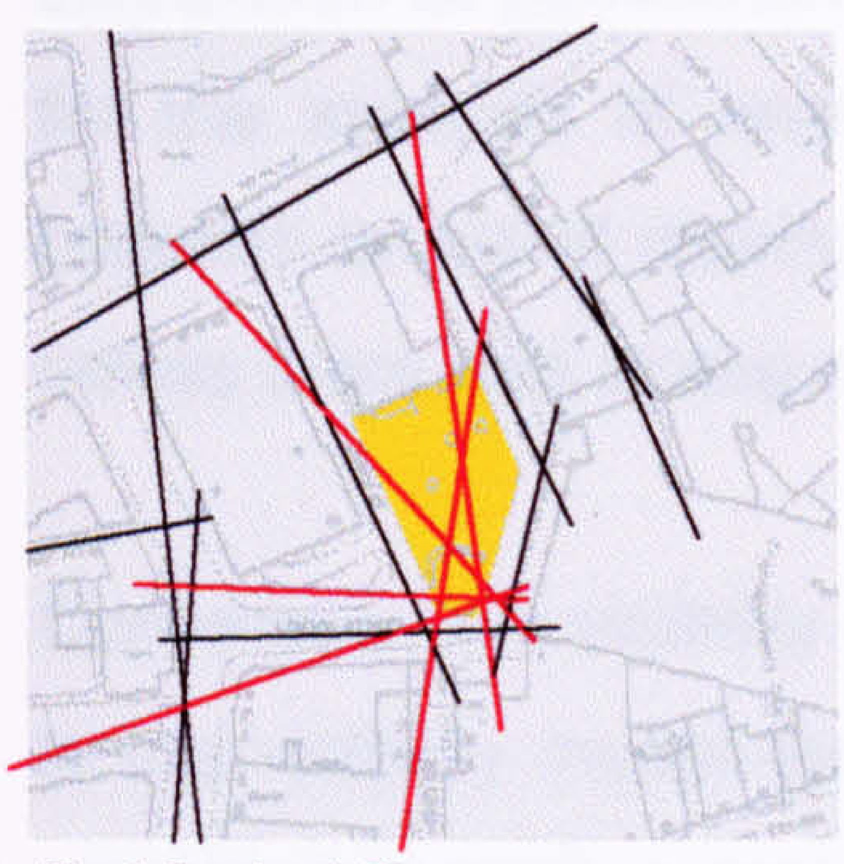

Fig. 4. Fenchurch Place

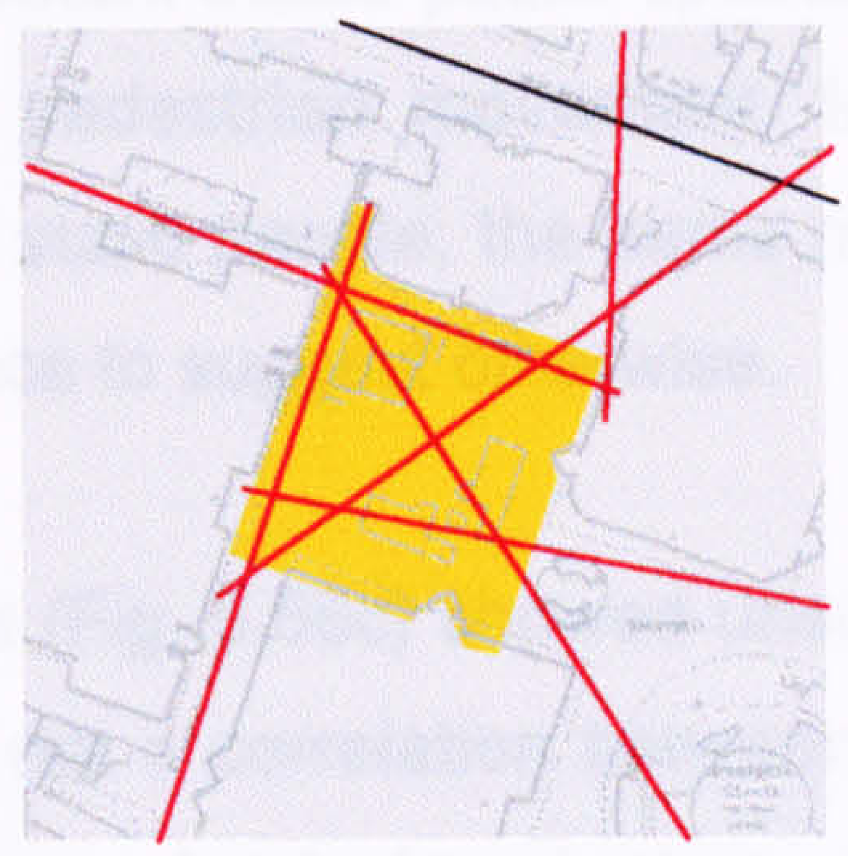

Fig. 5. Finsbury Av.

Fig. 6. Fleet Place

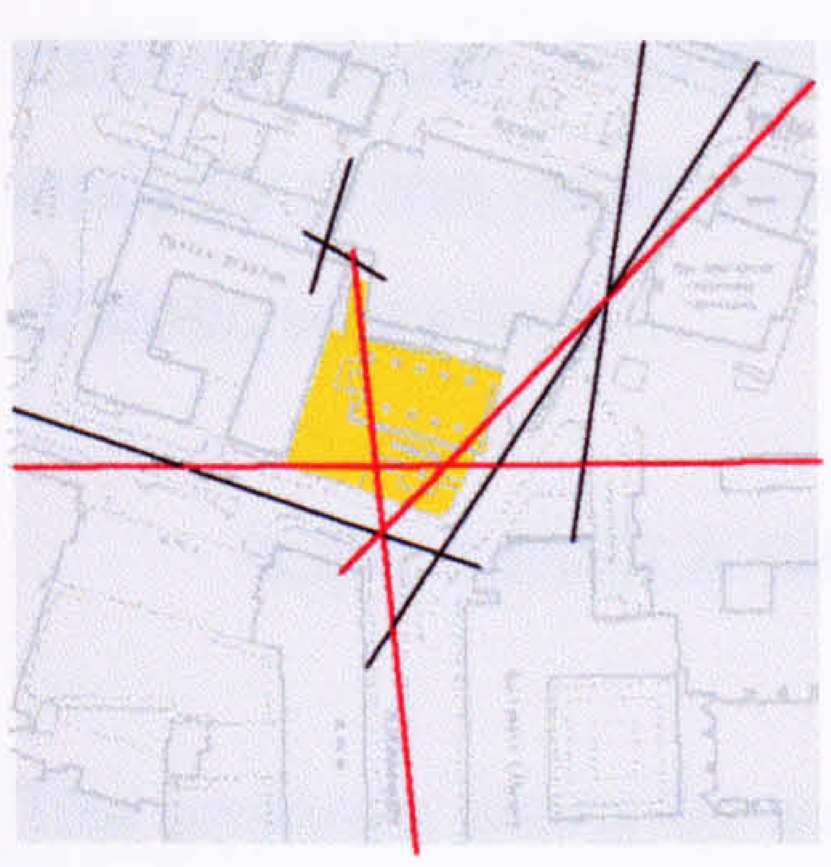

Fig. 7. Love Lane Corner

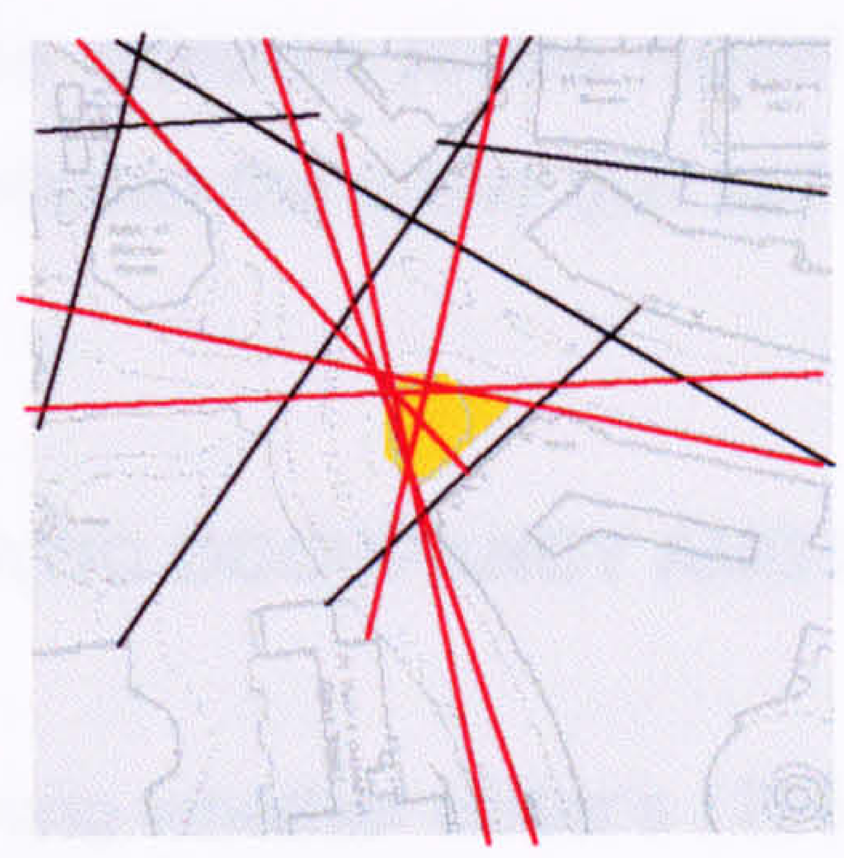

Fig. 8. New Change/Cheapside Corner

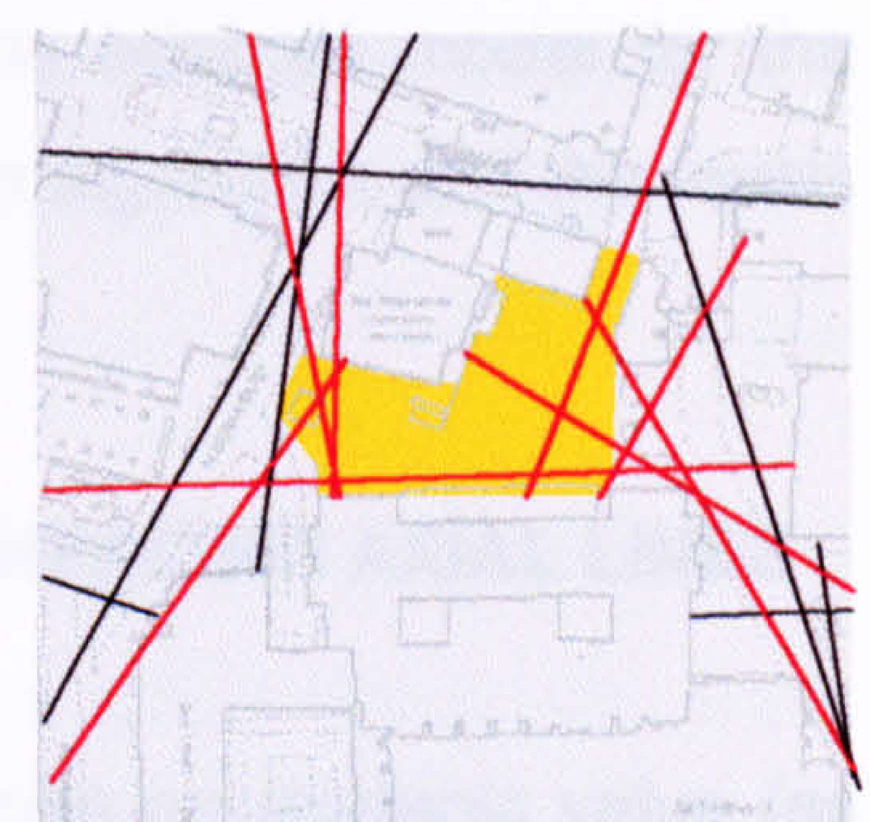

Fig. 9. North Guildhall

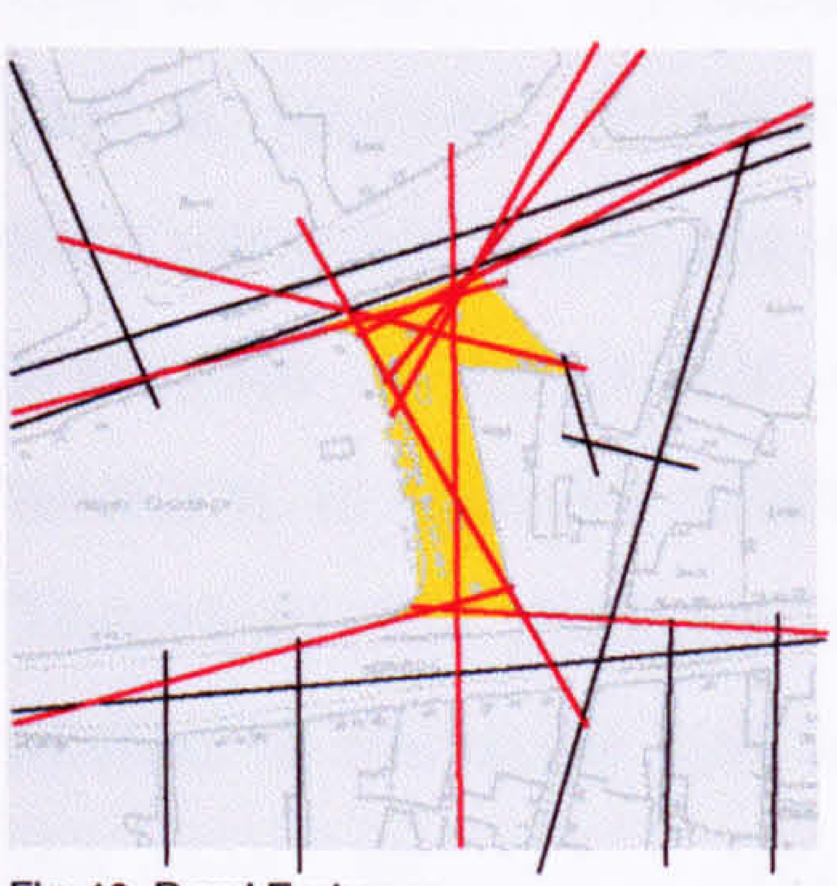

Fig. 10. Royal Exchange

Fig. 11. St. Anne & St. Agnes churchyard

Fig. 12. Whittington Gardens

The first item of information that we can extract form Figure 5.56 is that there is a strong linear correlation between the number of suits and the strategic value (this property will be further discussed in the next section). However, when comparing the three models, important variations are shown.

Firstly, only the scattergrams for the basic (Fig. 5.56a) and the effective routes (Fig. 5.56b) models show a linear correlation. However, both scattergrams look very similar. Through an analysis of the distribution of points along the regression line, the statistical significance of the R-squared and p values may suggest that the effective routes model is the model which equation best fits the data. However, there are other reasons that strongly suggest the effective routes model is the most appropriate of the three. The effective routes model, compared to the basic one, is truly representative of the distribution of pedestrian movement inside public spaces and it was successfully used for the analysis of levels of pedestrian movement. In addition, for a comparison between levels of moving and static people, the same model should be used for both, unless there was strong evidence to suggest otherwise.

Conversely, the visibility model (Fig. 5.56c) showed unsuitable. The fact that according to the visibility model there is not a correlation between the strategic value and static people, but such a property was clearly found when using the previous two models suggests that such a property does exist but that was inadequately quantified in the visibility model. Therefore, the effective routes model is the adopted model for the analysis of the relationship between the urban grid spatial configuration and the levels of static occupancy.

5.2.6. LEVELS OF STATIC OCCUPANCY AND INTERFACING AXIAL LINES

The analysis starts by examining whether Hillier's (1984) ideas on strategic value (as discussed in Section 2.5, Chapter 2) do exist for this sample of public spaces in the City of London. The study on static occupancy rates excludes the occasional users, that is, tourists, construction workers, and office smokers. This is not only because they were not the focus of this research but also because being occasional users their presence in the public spaces can be seasonal, as is the case with construction workers, or may be related to proximity to historical sites, as is the case with tourists. Therefore the analysis of levels of static occupancy throughout this section will be limited to the suits (not at pubs and at pubs) category. The study will concentrate on the data collected in July/August 1996, and the data collected in October 1996 will be used to verify the results. For the relationship between spatial, syntactic and levels of static occupancy, refer to Table 5.8 (correlation matrix) in Appendix 3.

The first step is to use the suits not at pubs category, as this data is common to all twelve public spaces for the twelve-hour observation period. The scattergram for the mean number of suits not at pubs observed during July and August together with strategic value shows a strong linear correlation (Fig. 5.57)[43]. The result proved consistent when the analysis of the mean number of suits at pubs together with strategic value for the same period also showed a linear correlation (Fig. 5.58).

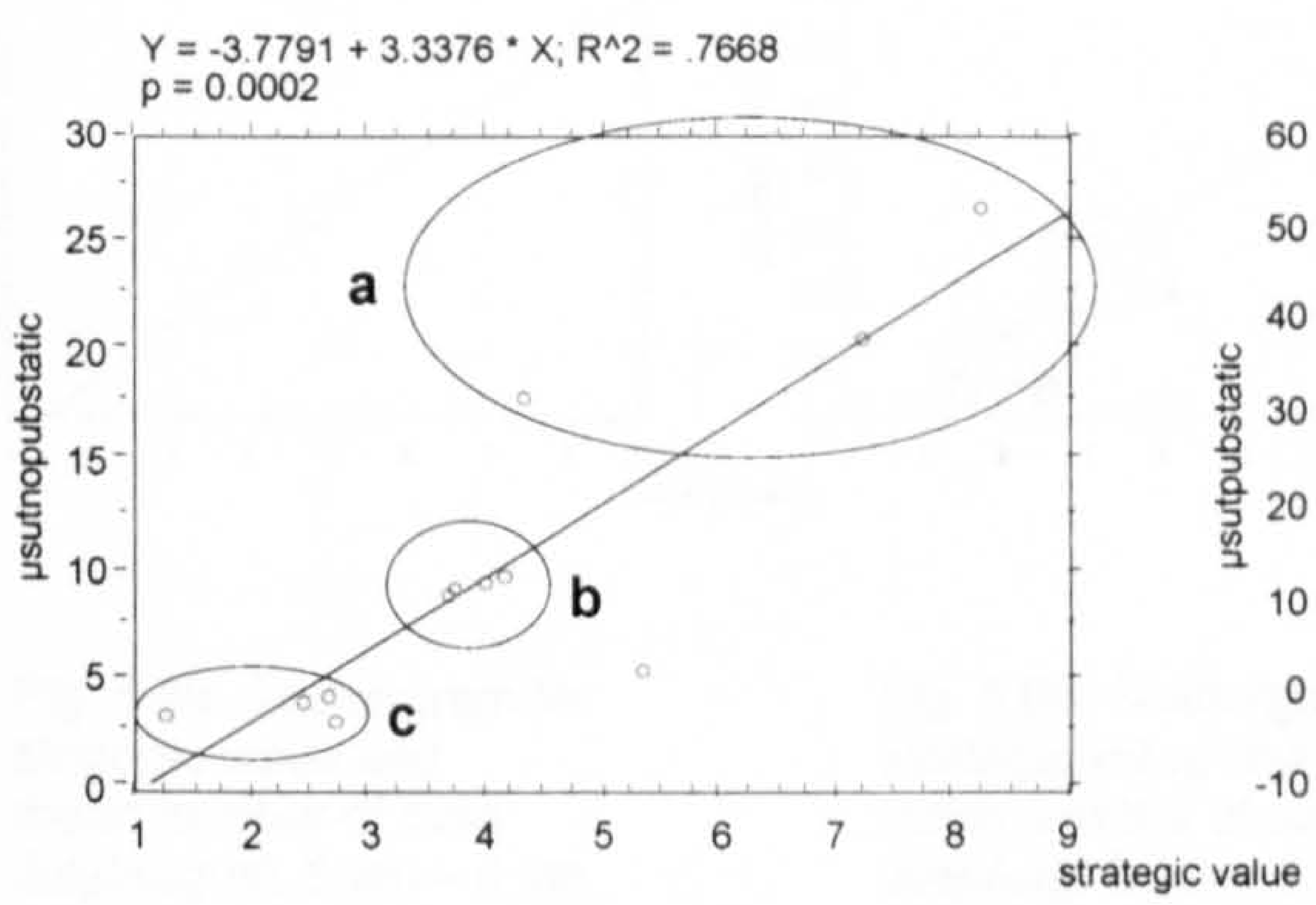

Fig. 5.57. Scattergram for strategic value and mean number of suits not at pubs
July/August data, 8 am – 8 pm
n = 12

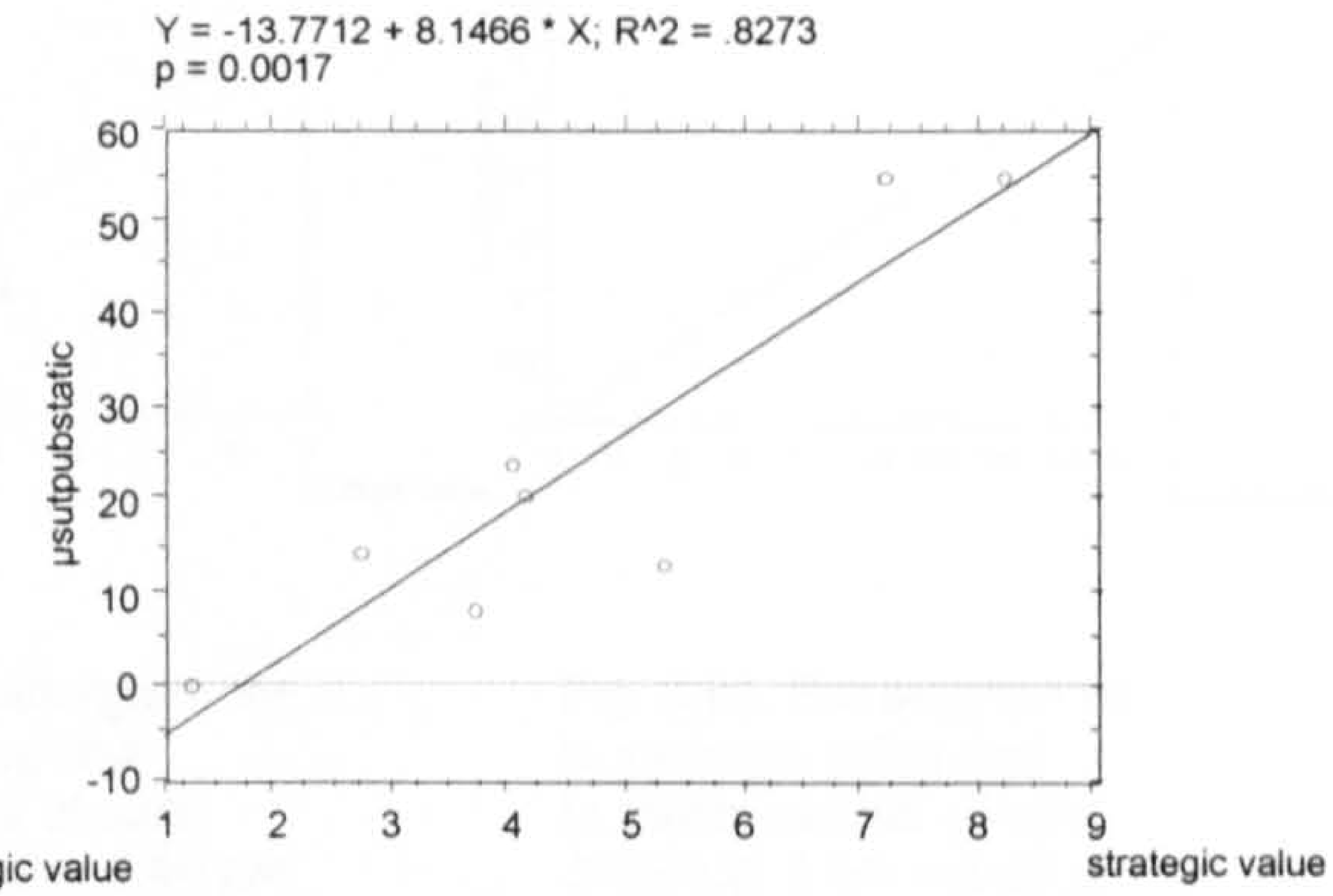

Fig. 5.58. Scattergram for strategic value and the mean number of suits at pubs
July/August data, 8 am – 8 pm
n = 8

Although the data so far has been dealt with separately for the suits not at pubs and the suits at pubs categories, the next stage is to look at how the suits category as a whole correlate with the strategic value, since both categories of users make informal use of public spaces at the same time.

From the description of levels of static occupancy (Section 5.2.3) there was some evidences suggesting that wine bars do not work as real attractors for static occupancy. The positive linear correlation between suits at pubs and suits not at pubs as illustrated in Figure 5.47 is an important finding. Also, the mean number of pub users for Finsbury Av. and Exchange Squares was virtually the same (Fig. 5.47) despite these being three wine bars in Exchange Square compared to only one in Finsbury Av. Also, there is the case of Abchurchyard that, despite a wine bar facing the public space, has the lowest daily level of static occupancy of all twelve cases. Although it is accepted that after 4:50 pm, public spaces with wine bars have a

[43] Areas a, b and c will be discussed in Section 5.3, at the end of this chapter.

different character than those without, it is conjectured that the wine bars on their own cannot guarantee the presence of static people during standard working hours. In fact, it is suggested that it is the configuration of the urban fabric that plays the major role in the level of static occupancy, and that the wine bars or other similar facilities play a more complementary part. To examine this aspect further, the research looks at the relation between the strategic value[44] and all suits for the eight public spaces with wine bars (Fig. 5.59) and all suits for all twelve public spaces from 8:00 to 4:40 pm (Fig. 5.60).

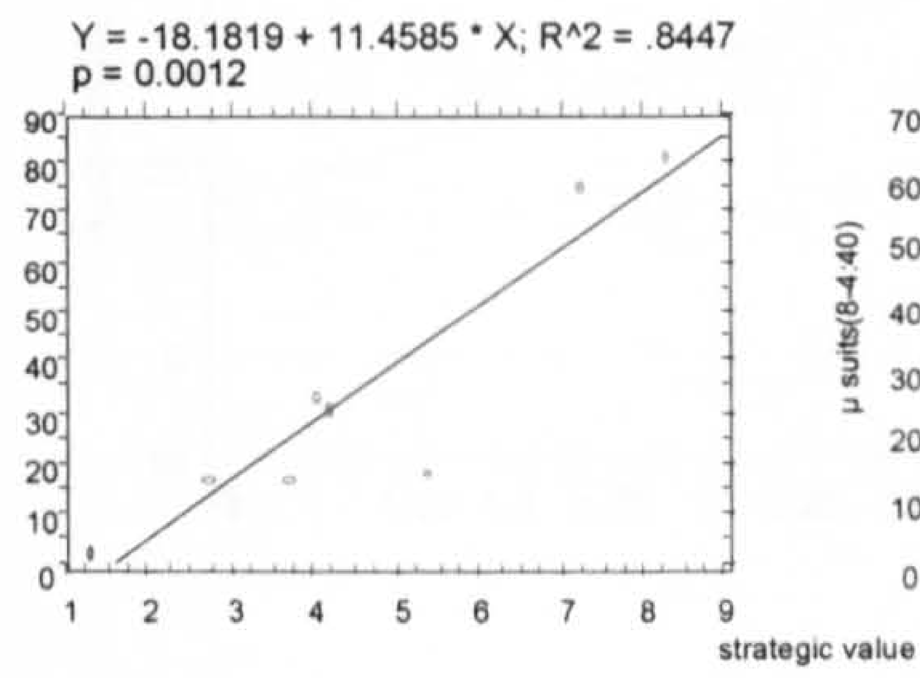

Fig. 5.59. Scattergram for strategic value and mean number of suits July/August, 8 am – 8 pm n = 8

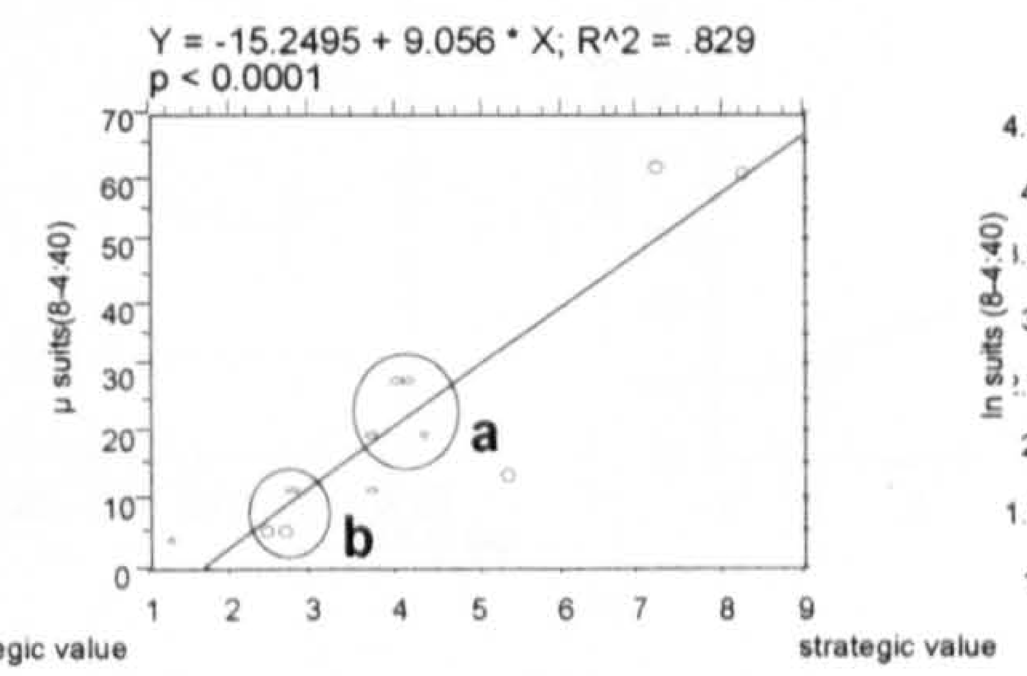

Fig. 5.60. Scattergram for strategic value and mean number of suits July/Aug, 8 am – 4:40 pm n = 12

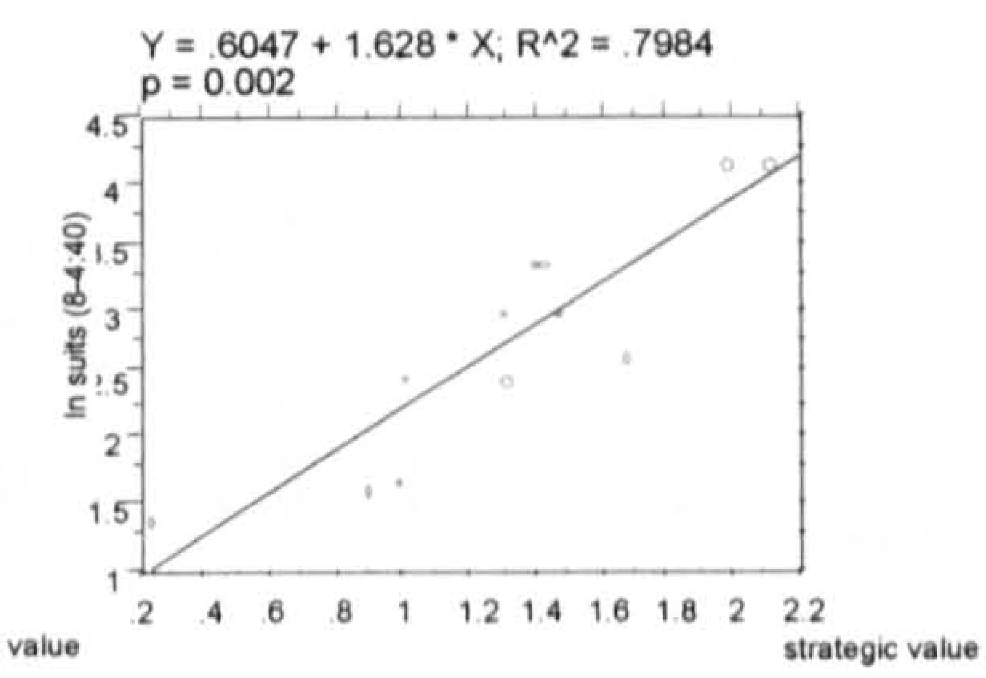

Fig. 5.61. Scattergram for ln strategic value and ln mean number of suits July/Aug, 8 am – 4:40 pm n = 12

Figures 5.59 and 5.60 show a strong positive liner correlation between the total number of suits and the strategic value. With the addition of the public spaces without pubs (Fig. 5.60) with a clustering of points at the lower left side, the data was normalised in Figure 5.61. The most important information that the scattergrams show, however, is that public houses and wine bars are unlikely to be effective major attractors. When analysing the total number of static people and integration values for various public spaces including some with catering facilities and some without we still come to a linear correlation, as shown in Figure 5.60.

The caterers are probably taking advantage of the configuration of the grid and the patterns of pedestrian movement and static occupancy associated with it. Harrinson (1987), in an article on successful environments for pedestrians in Oregon (USA), concluded that marketing was only effective when public spaces were already well used places with good levels of static occupation. This is further supported by Chidister's study (1986) of public spaces in Minneapolis (USA) who was also surprised to find out that highly used "plazas" were not close to restaurants and bars as he expected, but near to office buildings.

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[44] Ibid. 43.

When the number of suits at pubs is correlated against the number of wine bars (Fig. 5.62) and also including sandwich shops which entrance face the public space[45] (Fig. 5.63), in both occasions no positive correlation was found. From interviews with users (see Table 6.15, Chapter 6), only 10% of respondents said that the wine bars were their main reason for using the public space.

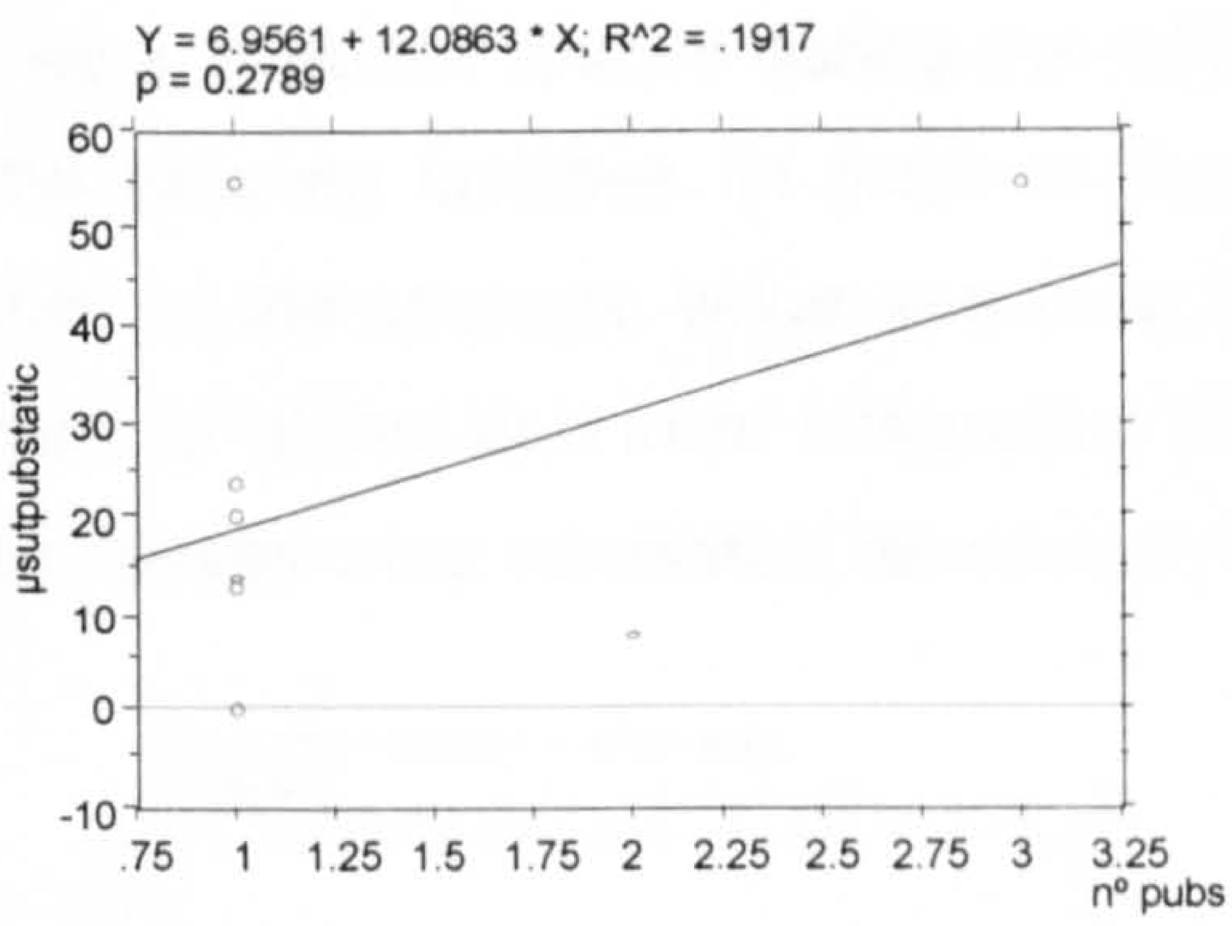

Fig. 5.62. Scattergram for the number of wine bars and the mean number of suits at pubs

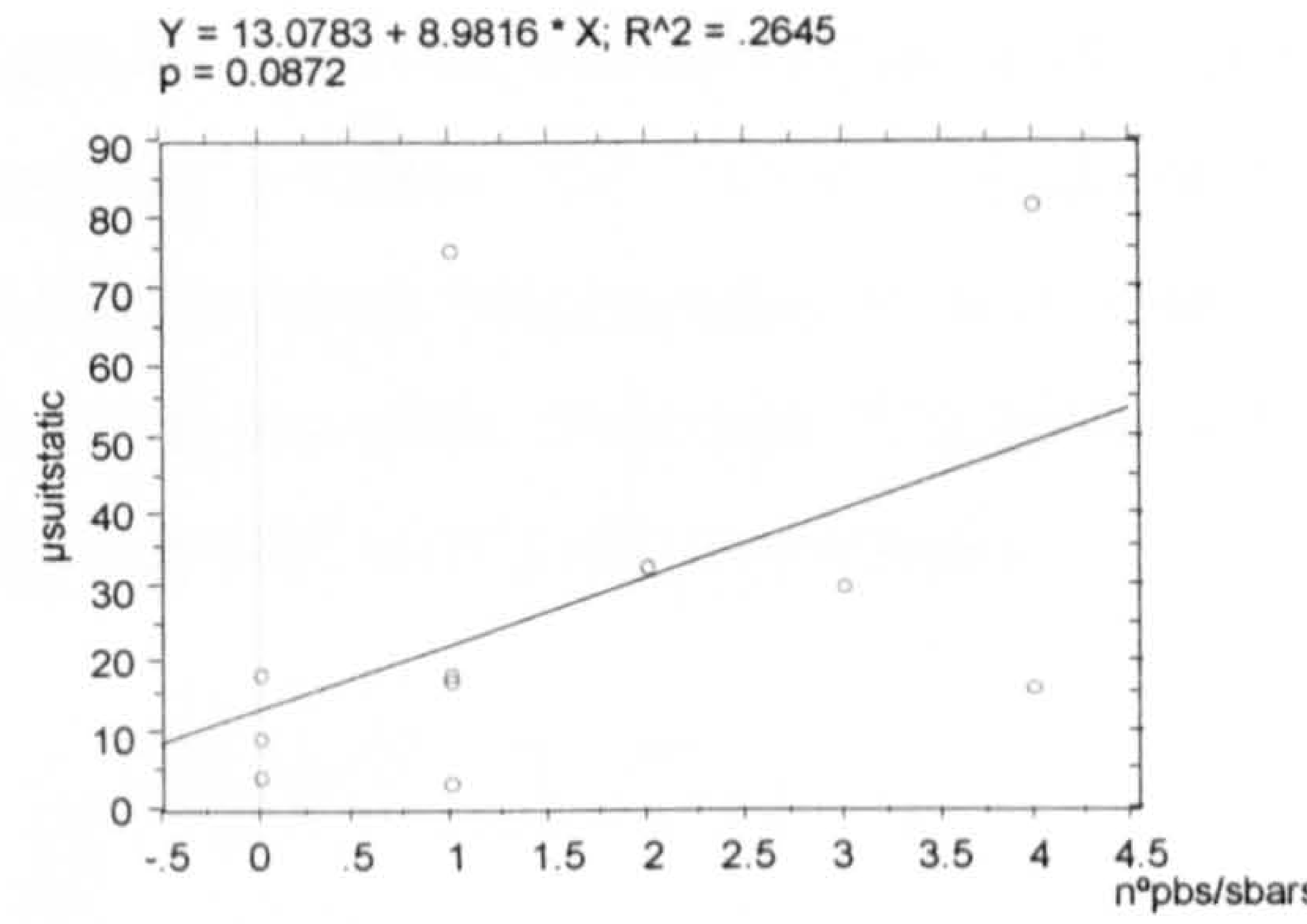

Fig. 5.63. Scattergram for the number of wine bars and sandwich shops and the mean number of suits at pubs

The analysis proceeded by correlating the number of static people and local strategic value. When the analysis was divided for suits not at pubs and suits at pubs the property holds for both occasions, with linear positive correlations (Figs. 5.64 and 5.65). The scattergram plotting the mean number of all static people from 8 am to 4:40 pm and local strategic value also showed a linear correlation (Fig. 5.66).

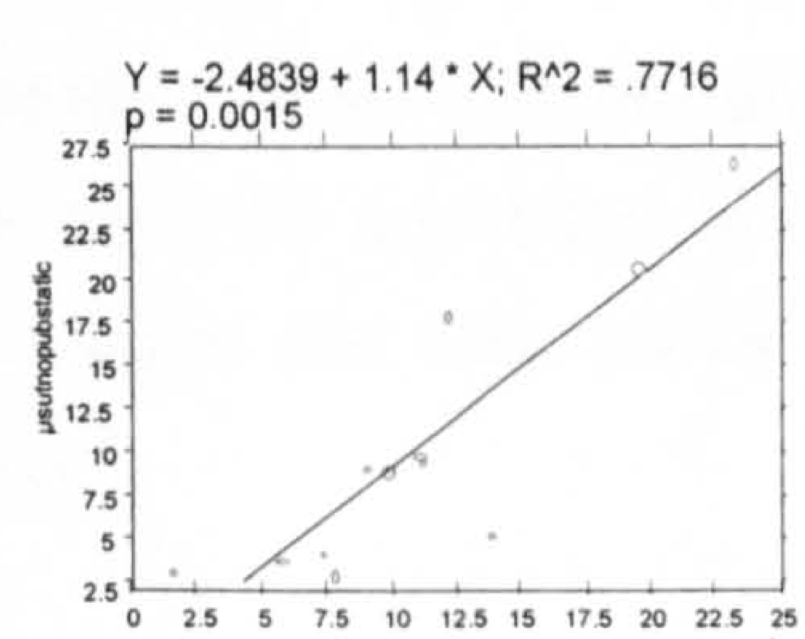

Fig. 5.64. Scattergram
local strategic value and
mean number of suits not at pubs
July/August, 8 am – 8 pm
n = 12

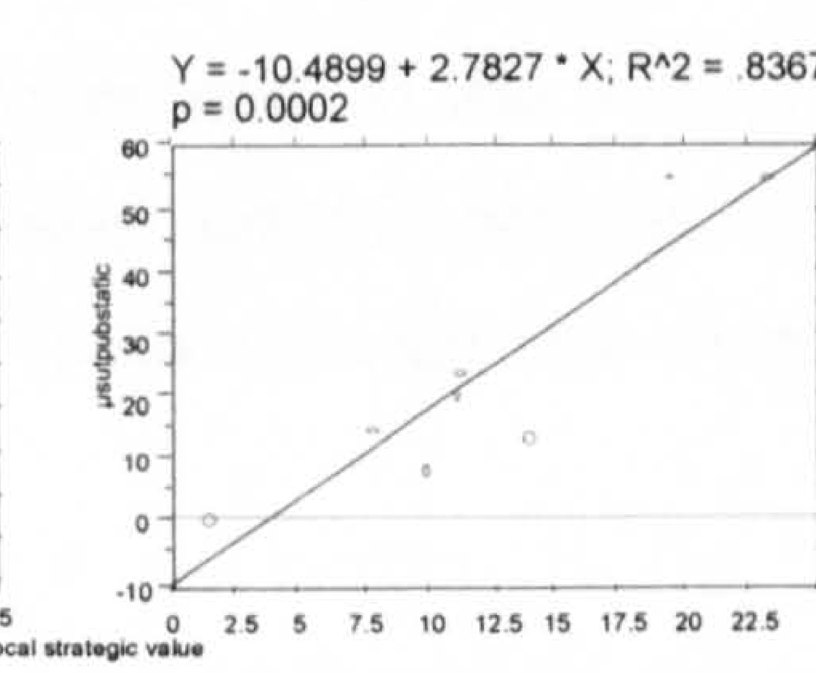

Fig. 5.65. Scattergram
local strategic value and
the mean number of suits at pubs
July/August, 8 am – 8 pm
n = 8

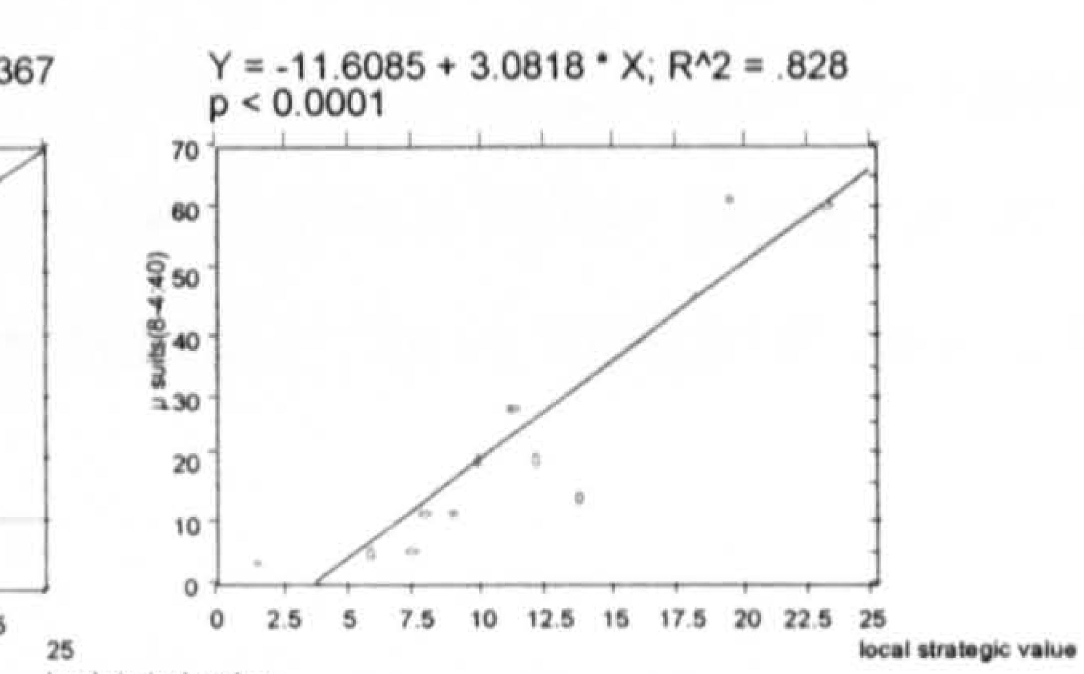

Fig. 5.66. Scattergram
local strategic value and
the mean number of all suits
July/August data, 8 am – 4:40 pm
n = 12

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45 "Face the public space" indicates that the pubs/wine bars/sandwich shops had a main entrance facing the public space, or a maximum of 15 metres away.

It is suggested that during the traditional working hours of 9 am to 5 pm (in fact the data used for the analysis is from 8 am to 4:40 pm), the wine bars or catering facilities have little impact on the levels of static occupancy in public spaces. Yet, public spaces do hold different identities throughout the day, as the situation reverses after 5 pm. Public spaces with wine bars and similar facilities do present much higher levels of static occupancy than those without. Indeed, it is clear from the observational data that the users of public spaces during the 4:50 pm to 8 pm period are these predominantly for the catering facilities. In order to investigate whether the number of users are a function of the strategic value and local strategic value, the number of pub users and the sum of global and local integration values of the axial lines that interface with the public spaces were correlated, as seen in Figures 5.67 and 5.68 respectively.

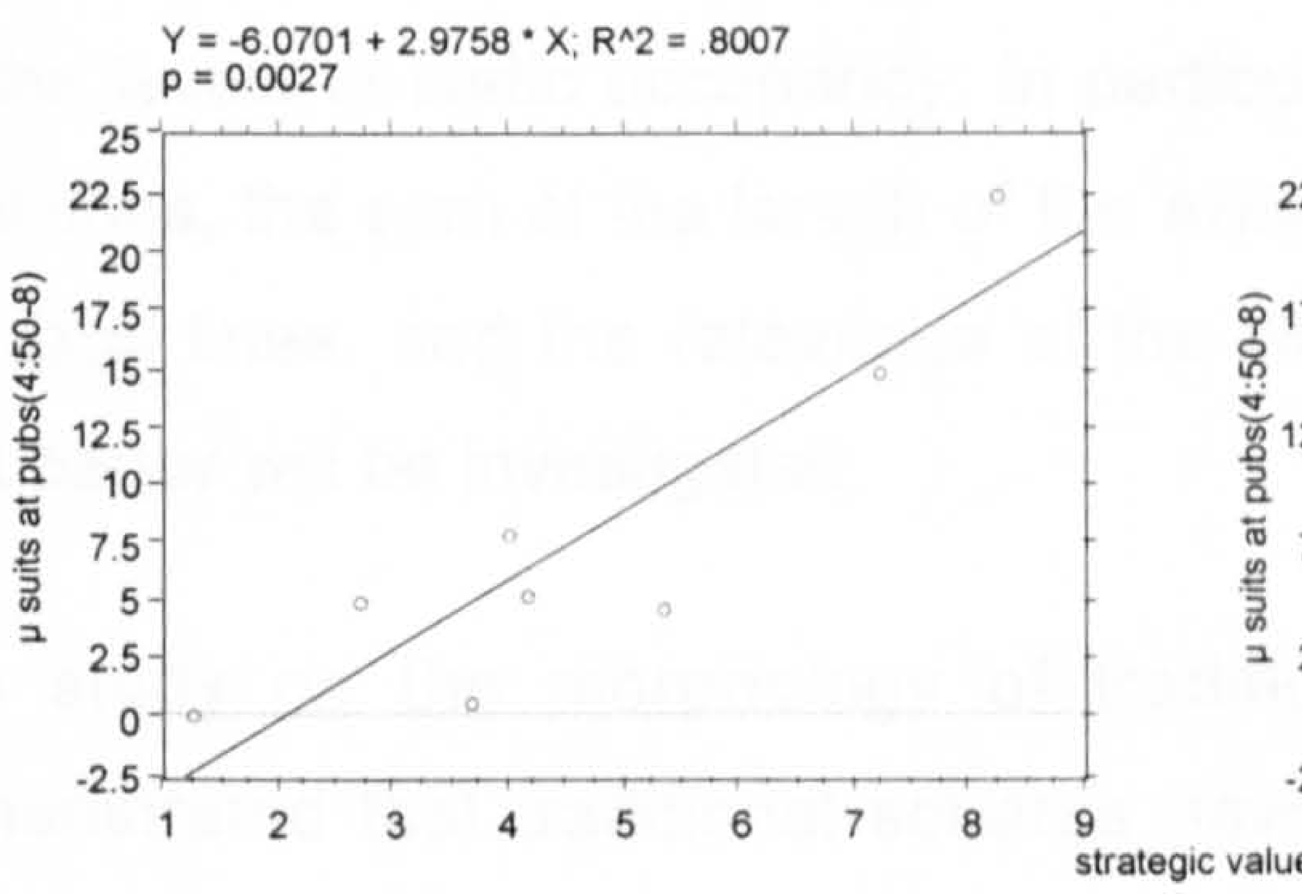


Fig. 5.67. Scattergram for strategic value and mean number of suits at pubs July/August data, from 4:50 pm - 8 pm

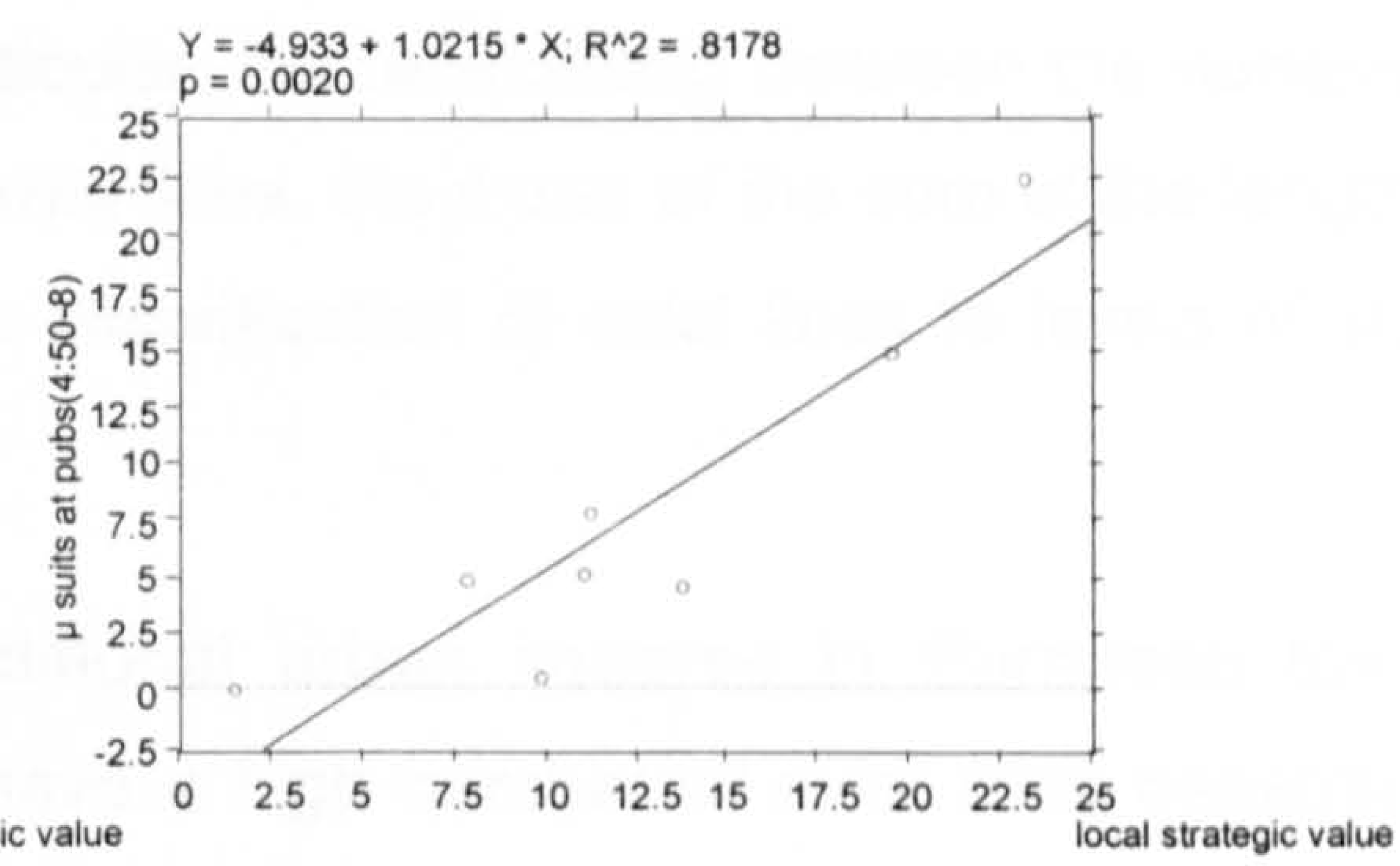
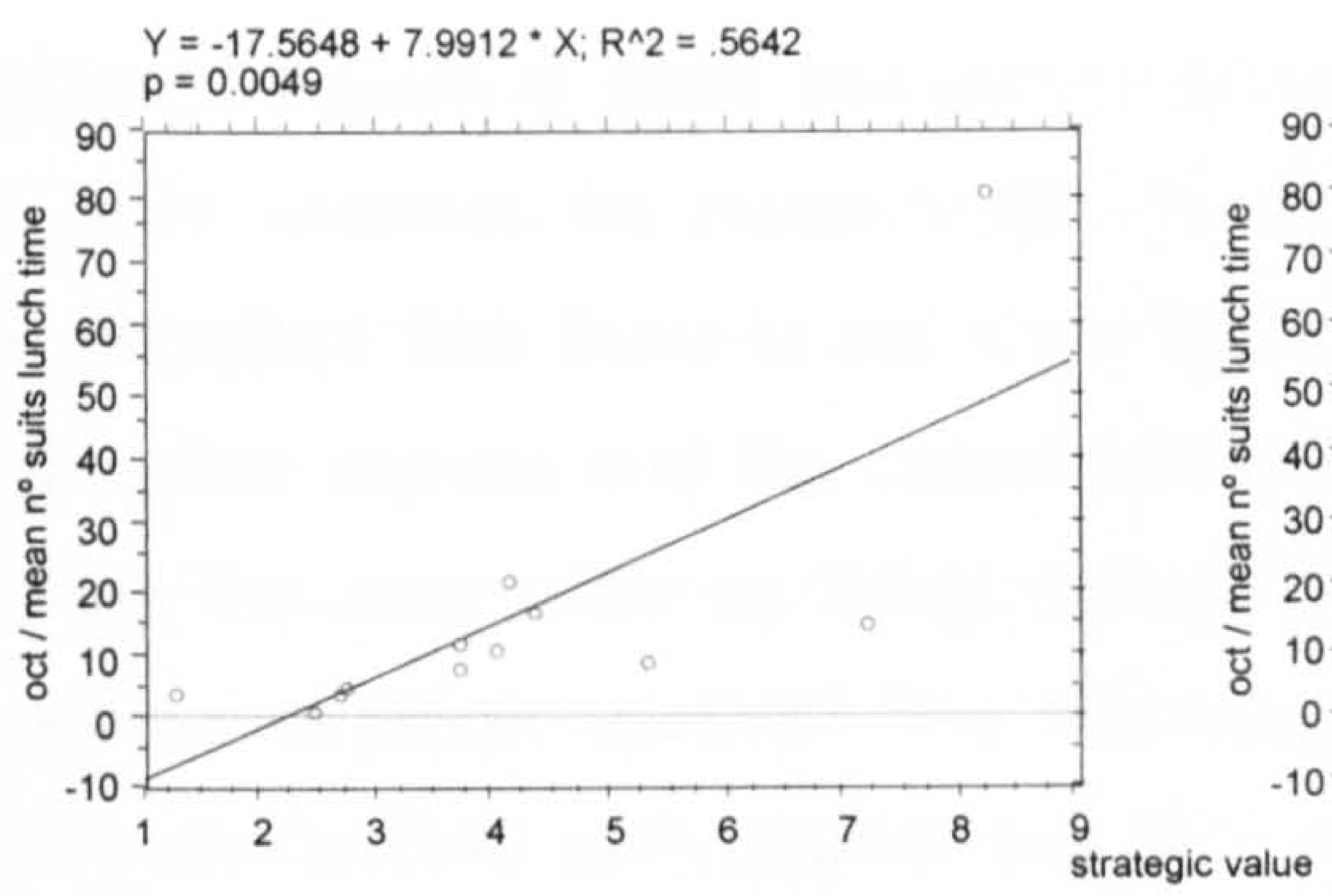


Fig. 5.68. Scattergram for local strategic value and the mean number of suits at pubs July/August data, from 4:50 pm - 8 pm

The results show that the number of pub users (after 4:50 pm) is again a result of the strategic value, and not proportional to the number of pubs or wine bars, as seen in Figures 5.62 and 5.63. In other words, users go to the public spaces because of the wine bars but they arrive there through the morphological properties of the urban fabric.

However, could this property between the number of static people and strategic value exist due the good levels of static occupancy rate during the summer? To evaluate this, the study was carried out for the data collected during October 1996. The results showed consistent with previous analysis, although the data was collected only at lunchtime and when the weather was unsettled, which explains the irregular distribution of some of the cases. The data for the mean number of static people and strategic value and local strategic value showed positive linear correlations in both cases (Figs. 5.69 and 5.70).



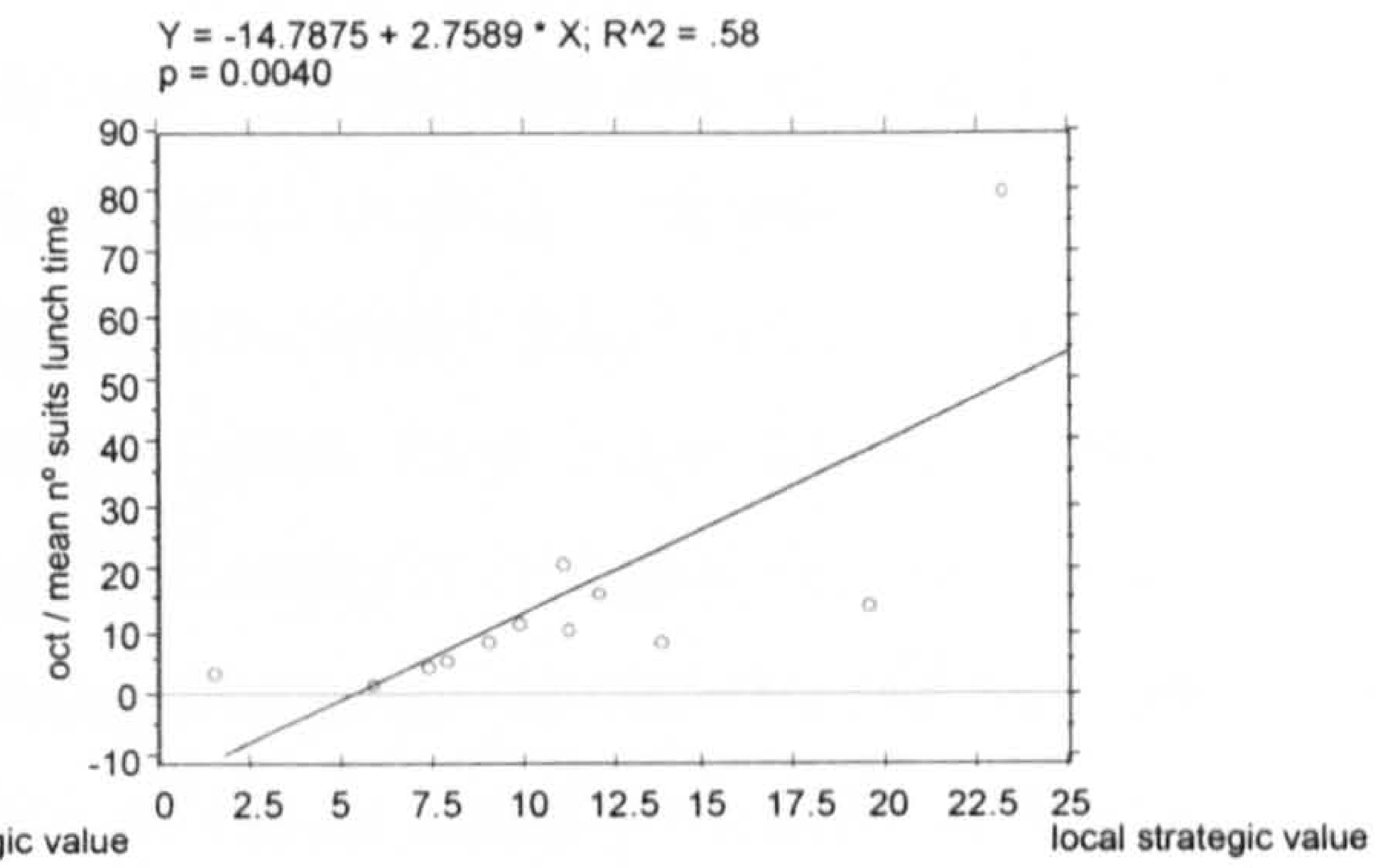
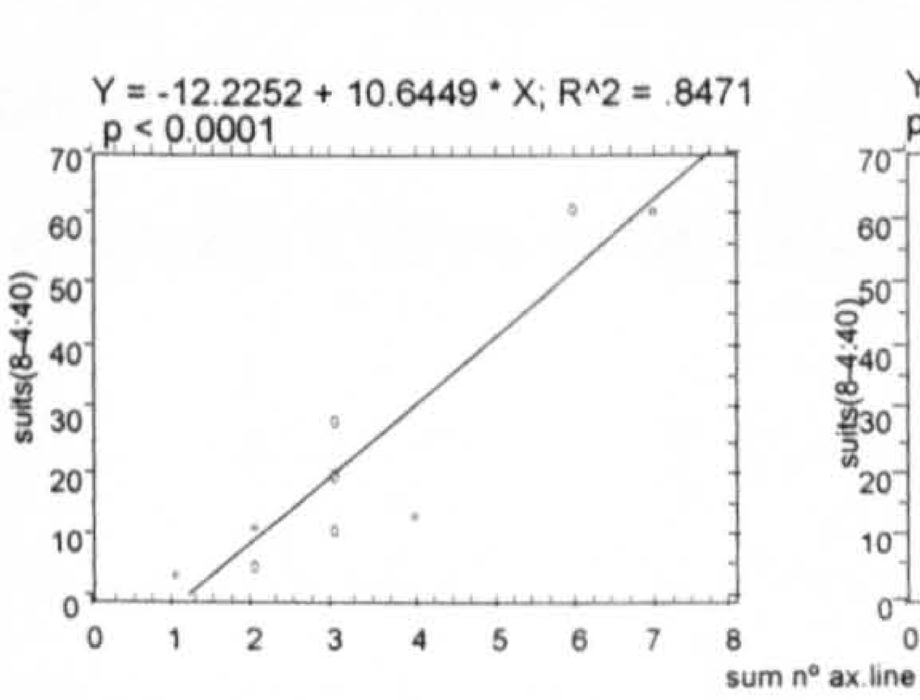


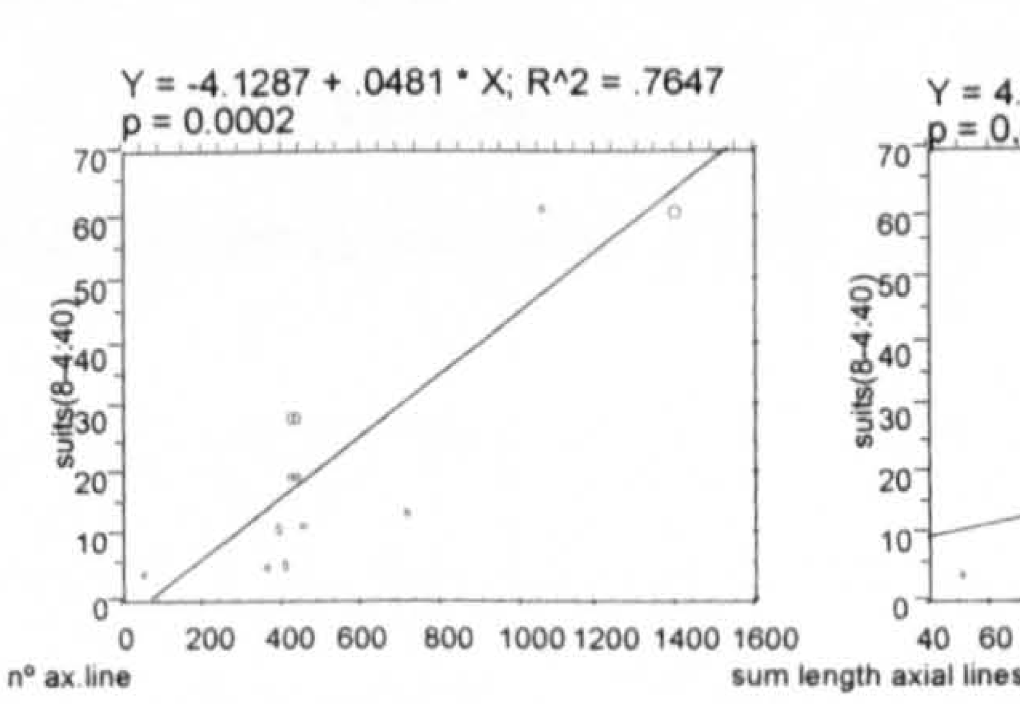
Fig. 5.69. Scattergram for strategic value and the mean number of suits, Oct data

Fig. 5.70. Scattergram for local strategic value and the mean number of suits, Oct data

The positive correlation between strategic value and levels of static occupancy raises several questions about other properties of the urban fabric that might also be relevant for the levels of static occupancy. In particular, the relationship between the number of axial lines, the sum of the length of the axial lines, the mean of the sum of the length of the axial lines, and the relevance of the classification of axial lines to levels of static occupancy will be investigated.

The study on the morphology of traditional urban squares in European towns, demonstrated that traditional squares have a high number of axial lines penetrating into the public space (mean number of 5.3 axial lines per urban space). The public spaces that perform best in this current survey (Finsbury Av. and Exchange Square), considering the total number of static people, are precisely the ones that have by far the highest number of axial lines intercepting with the public space (6 and 8 respectively). This is expected because generally there is a strong linear correlation between the sum of integration values and the number of axial lines, as we can see from the correlation matrix (Table 5.8, Appendix 3). Thus, the relationship between the number (Fig. 5.71), sum of the length (Fig. 5.72) and mean length of the axial lines (Fig. 5.73) and levels of static occupancy. The analysis shown in Figures 5.71 to 5.76 are for the mean number of suits, from 8 am to 4:40 pm, for the months of July/August.





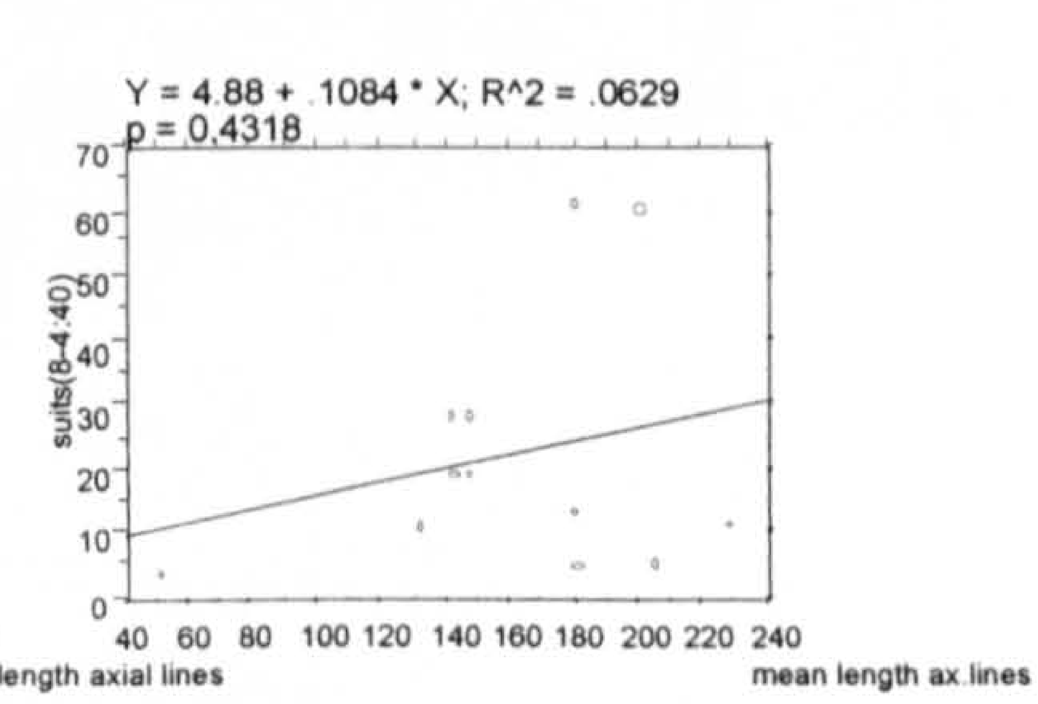


Fig. 5.71. Scattergram sum of number of axial lines and mean number of suits

Fig. 5.72. Scattergram sum of the length of the axial lines and the mean number of suits

Fig. 5.73. Scattergram mean of the sum of the length of axial lines and the mean number of suits

The results showed consistent with previous results on patterns of pedestrian movement. Levels of static occupancy are a function of the number and length of the axial lines, whereas the mean length of the axial lines is irrelevant. In addition, it has been identified that there is not a correlation between the number of moving people inside public spaces and the classification of axial lines. How does the differentiation between the axial lines as firstly defined in Chapter 3 relate to the levels of static occupancy of public spaces? The data was analysed by plotting the number of suits (from 8 am to 4:40 pm) against the sum of the integration values of the axial lines according to the classification.

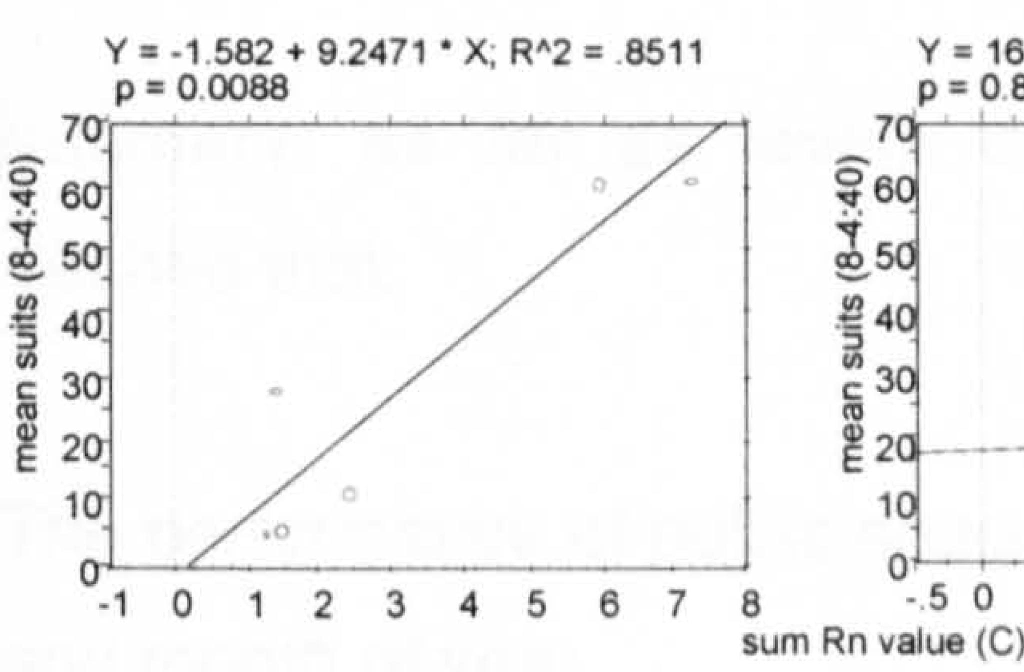


Fig. 5.74. Scattergram for the sum Rn C axial lines and mean number of suits

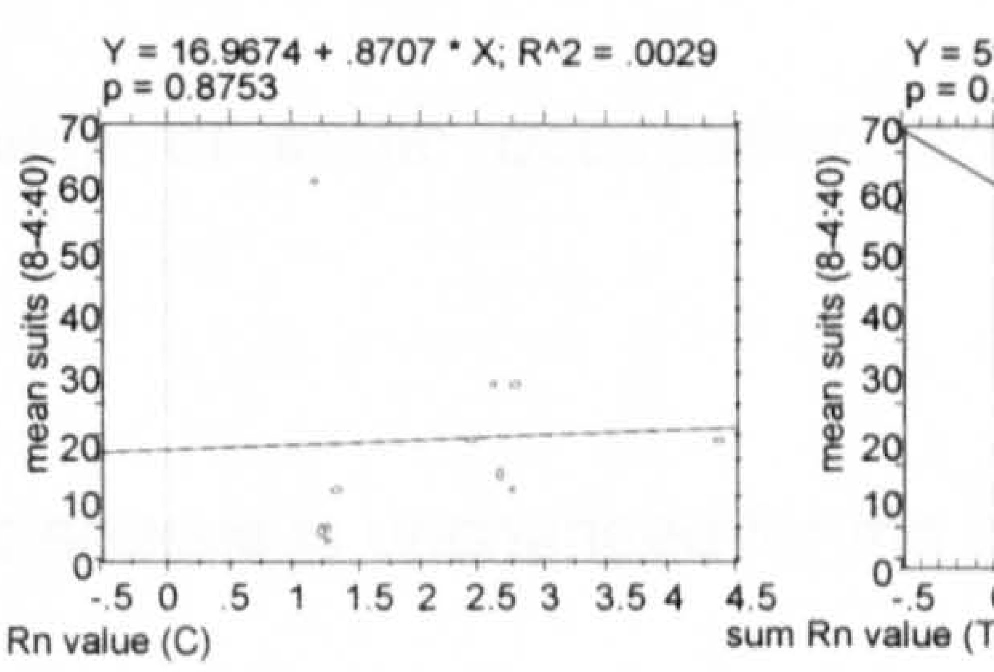


Fig. 5.75. Scattergram for sum Rn T axial lines and the mean number of suits

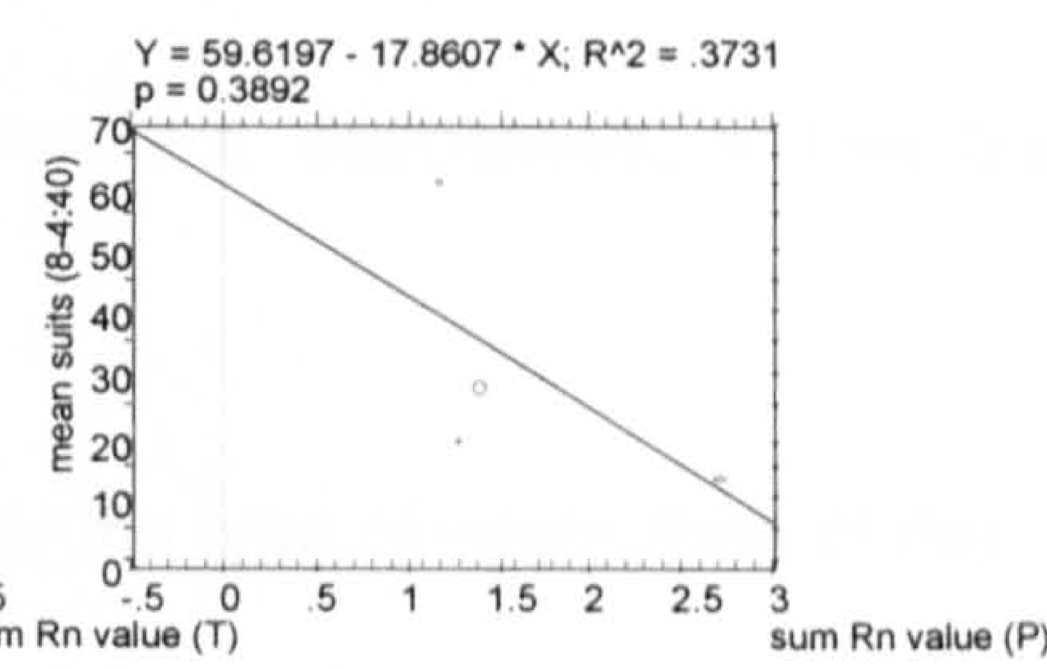


Fig. 5.76. Scattergram for sum Rn P axial lines and the mean number of suits

With the exception of the convergent axial lines (Fig. 5.74), no correlation was found for transverse and peripheric axial lines (Figs. 5.75 and 5.76), despite the fact that transverse axial lines represent 46% of all cases and are present in 11 out of 12 public spaces[46]. With regards to convergent axial lines, although a positive linear correlation was found between the two variables, they are present in only 6 out of 12 public spaces (representing 41% of all lines) and therefore the results cannot be representative of the sample[47].

As regards the embedding property, based on previous results for moving people, the relationship between levels of static occupancy and the global integration value of the public space is likely to be independent, as seen from Figure 5.77.

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[46] Effective routes model.

[47] The same results were found for suits not at pubs (8 am to 8 pm) and suits at pubs.

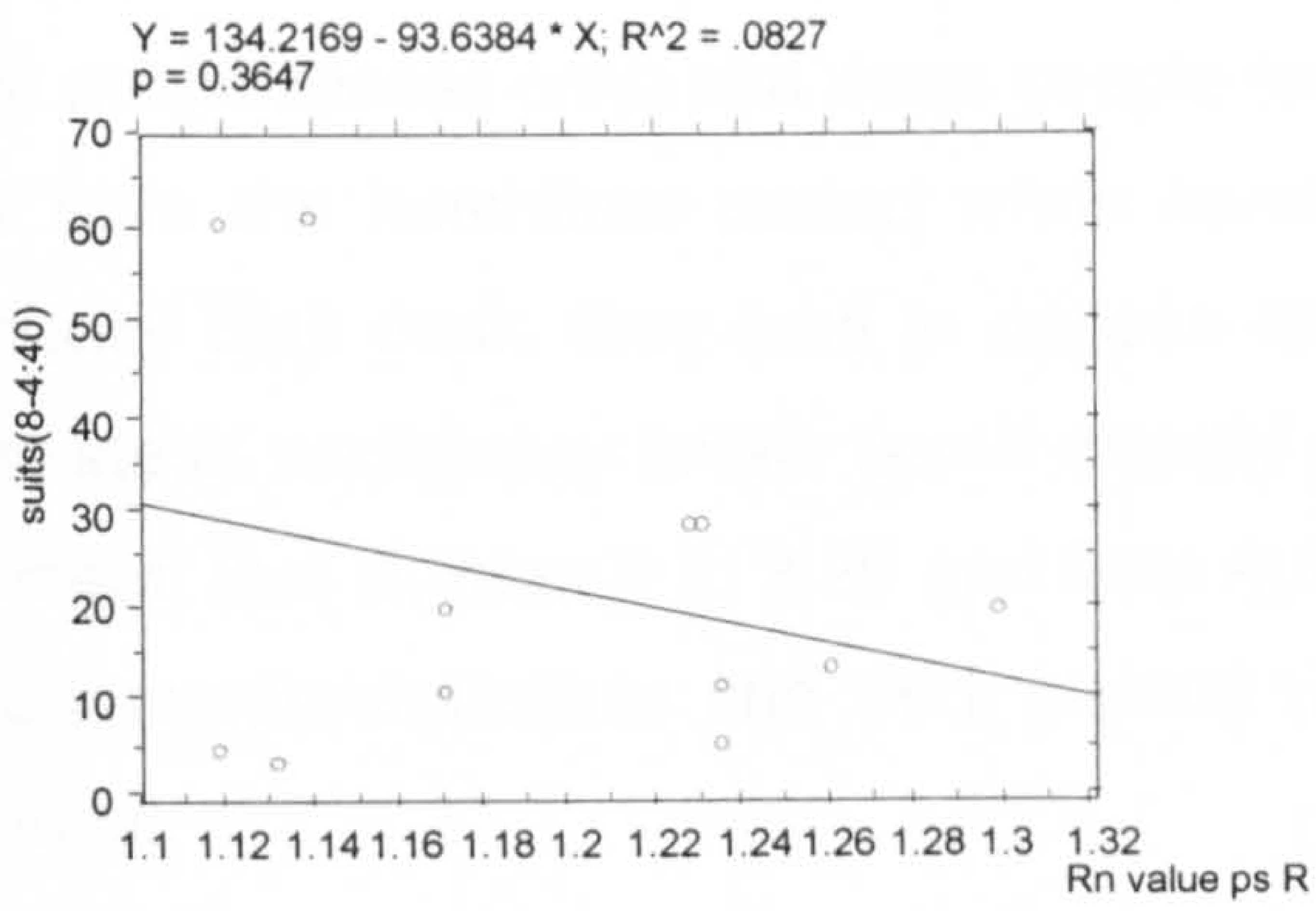

Figure 5.77. Scattergram global integration value of public space and mean number of suits, July/August data, from 8 am to 4:40 pm

In summary, as far as levels of static occupation are concerned, it has been established that:

- The performance of public spaces is unchanged for the type of users, time of day and month of year.
- The mean number of static people is a function of strategic value and local strategic value.
- The mean number of static people is related to the sum of the number of axial lines
- The mean number of static people is related to the sum of the length of the axial lines
- The mean number of static people is independent of the mean of the sum of the length of the axial lines.
- The mean number of static people cannot be associated to types of axial lines.
- The mean number of static people is independent of the global integration value of the public space.

5.3. COMPARING LEVELS OF PEDESTRIAN MOVEMENT TO LEVELS OF STATIC OCCUPANCY

The study showed that for all properties investigated for both moving and static people, from isovists to types of axial lines, the results, whether positive or negative, were common to both cases. This provides strong evidence that the number of static people is a result of the number of moving people inside public spaces, being quantified mainly from the strategic value.

However, for individual time periods (Fig. 5.78), the relationship between moving (inside public spaces only) and static people (suits category) is not always proportional. Apart from the lunchtime period when levels of pedestrian movement and static occupancy both peak, they tend to oppose each other. If we exclude pub users, the lowest static occupancy levels occur exactly during the highest levels of pedestrian movement, that is, from 8 to 9:20 and from 4:50 to 6:10 (the commuting time between train/underground stations and work places) when pedestrian movement can be very directional.

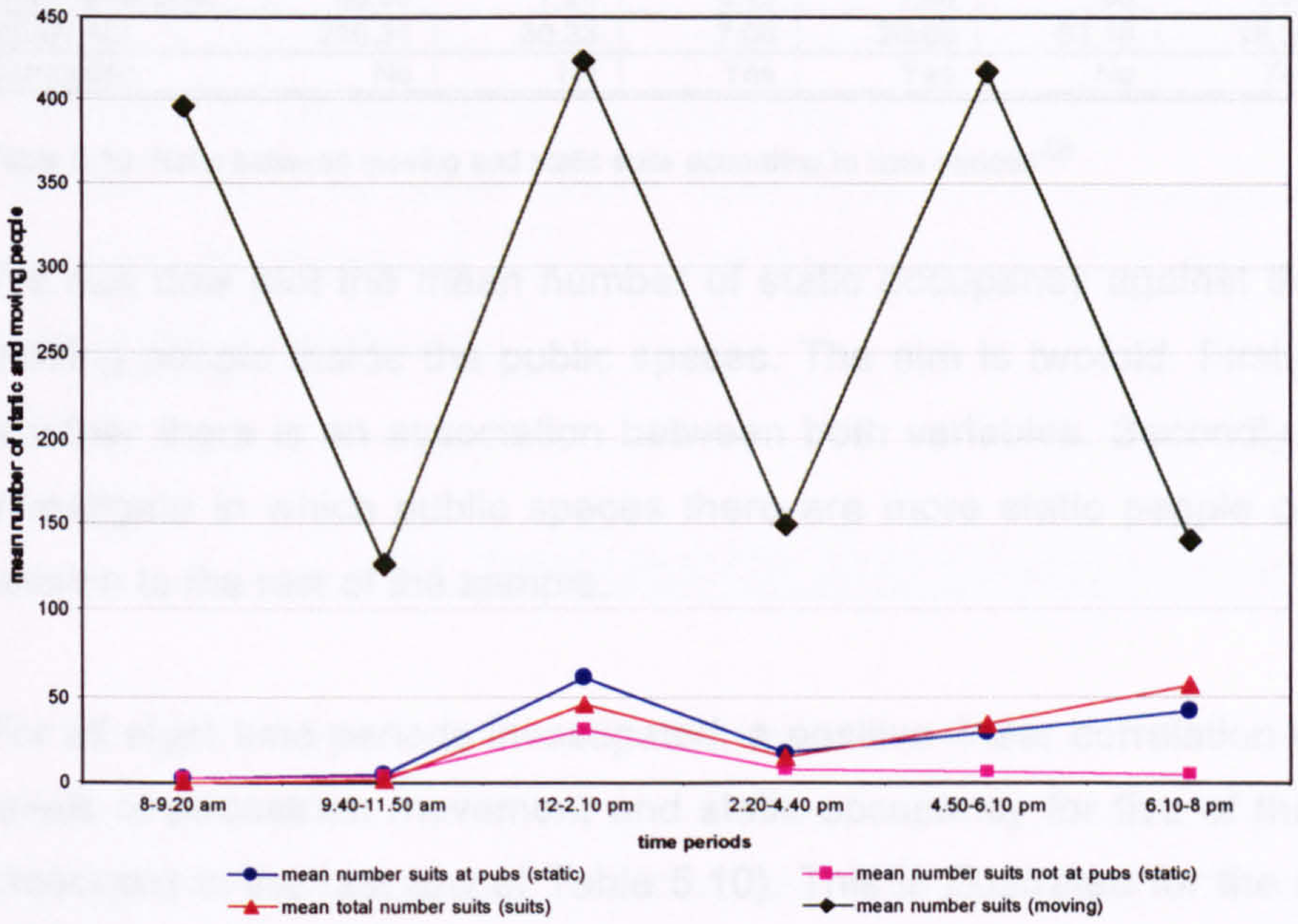

Fig.5.78. The relationship between static and moving people according to time periods
Mean of the twelve public spaces

categories	8-9:20 am	9:40-11:50 am	12-2:10 pm	2:20-4:40 pm	4:50-6:10 pm	6:10-8 pm
Mean nº suits at pubs (static)	0.00	1.57	46.45	15.18	34.39	56.47
Mean nº suits not at pubs (static)	2.46	3.94	30.96	7.49	6.64	4.58
Mean nº all suits (static)	2.46	4.99	61.93	17.61	29.57	42.23
Mean nº suits (moving)	397.30	126.63	424.03	149.47	417.60	141.00

Table 5.9. The relationship between static and moving people according to time periods summary data

Also, an analysis of the ratio between moving and static people in the City of London's public spaces showed a considerable variation from public space to public space, and according to the different times of day, as illustrated by Table 5.10.

Public space name	Ratio suits moving/ static 8:00 to 9:20 am	Ratio suits moving/ static 9:40 to 11:50 am	Ratio suits moving/ static 12:00 to 2:10 pm	Ratio suits moving/ static 2:20 to 4:40 pm	Ratio suits moving/ static 4:50 to 6:10 pm	Ratio suits moving/ static 6:20 to 8:00 pm	Ratio suits moving/ static 8:00 to 4:40 pm	Ratio suits moving/ static all day
Abchurchyard	70.00	24.00	2.59	30.00	34.29	67.20	16.33	17.21
Bank Corner	108.97	17.07	3.56	9.13	27.90	15.14	12.85	14.87
Exchange Square	92.59	15.55	7.80	7.54	11.39	1.38	8.93	7.04
Fenchurch Place	317.33	27.03	6.78	20.14	77.19	48.31	22.01	28.79
Finsbury Av.	575.68	63.36	6.07	5.33	8.54	2.12	10.85	8.40
Fleet Place	102.38	17.45	13.61	7.44	12.27	5.49	15.78	12.11
Love Lane Corner	58.43	9.82	.95	4.95	21.18	16.59	4.17	4.72
New Change	96.00	10.87	1.38	0	0	4.33	2.60	3.30
North Guildhall	840.00	132.00	25.77	135.48	540.00	*	64.90	84.09
Royal Exchange	210.76	31.12	11.50	13.15	24.58	2.91	20.27	18.06
St. Anne	12.00	8.47	.99	6.40	0	37.33	2.85	2.73
Whittington Gds.	39.53	7.24	4.13	1.50	.98	1.02	4.81	3.26
MEAN ALL	210.31	30.33	7.09	20.09	63.19	18.35	15.53	17.05
Correlation	No	No	Yes	Yes	No	Yes	Yes	Yes

Table 5.10. Ratio between moving and static suits according to time periods[48]

We can now plot the mean number of static occupancy against the mean number of moving people inside the public spaces. The aim is twofold. Firstly, we can examine whether there is an association between both variables. Secondly, we will be able to investigate in which public spaces there are more static people or moving people in relation to the rest of the sample.

For all eight time periods investigated, a positive linear correlation was found between levels of pedestrian movement and static occupancy for five of them (the results are presented in the last row of Table 5.10). This is illustrated for the lunchtime and mid-afternoon periods (Fig. 5.78). In the case of the 6:20 – 8 pm period, although we see low levels of moving people and high levels of static people, it is very likely that most of pedestrian movement is "to-movement" associated to wine bars. In fact, the lack of correlation for the early morning periods (mainly the 8 – 9:20 am one) is expected. During this time, the correlation analysis merely highlights that some public spaces, due to their strategic locations (such as Fenchurch Place of Finsbury Av.), canalise pedestrian movement of the area (this will be further discussed in Chapter 6). The next two scattergrams summarise the findings.

[48] Obs. In the case of New Change/Cheapside Corner and St. Anne & St. Agnes churchyard, "zero" means that no moving person was observed for the respective time periods. For North Guildhall, the "star" means that no static person was observed during the time period. Refer to general data Table 5.1 in Appendix 3.

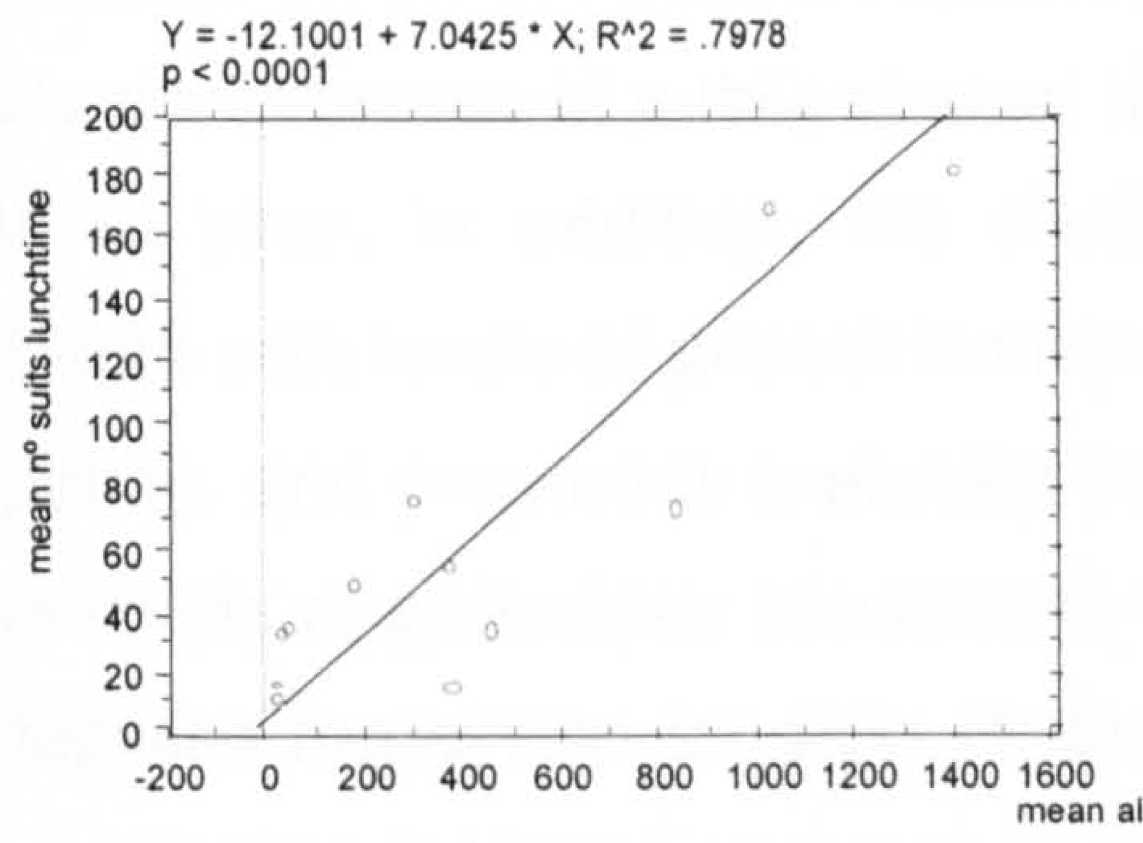

Fig. 5.79. Scattergram for the mean number of moving suits and static suits (12:00 to 2:10 pm)

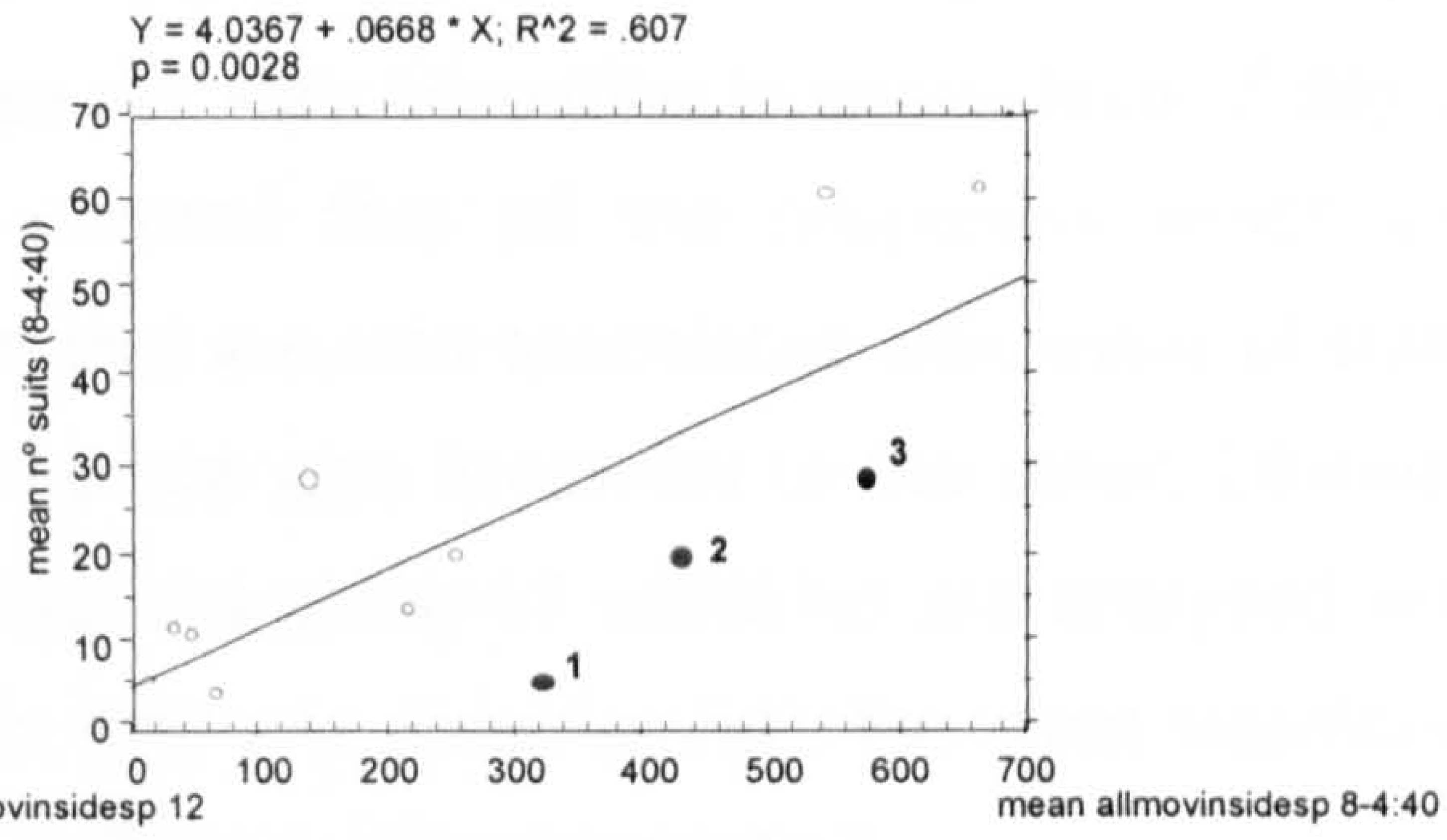

Fig. 5.80. Scattergram for the mean number of moving suits and static suits (8:00 am to 4:40 pm)

Figure 5.79 shows the strong relationship for the lunchtime period. Figure 5.80 illustrates the relationship for the whole day (8 am to 4:40 pm), highlighting that despite the fact that some public spaces have higher levels of pedestrian movement (North Guildhall (1), Fenchurch Place (2) and Royal Exchange (3)), the relationship is still very strong throughout the day.

5.4. DISCUSSION AND CONCLUSIONS

From the study on levels of pedestrian movement, it became clear that, the configuration of the City of London urban fabric possesses a good degree of intelligibility, meaning that based on the theory of natural movement (Hillier et al., 1993a) we should expect good correlations between levels of pedestrian movement and integration values of axial lines. However, although the levels of pedestrian movement are positively associated to the spatial structure of the urban fabric, the levels of pedestrian distribution inside the public spaces follow a different spatial logic.

The analysis on levels of pedestrian movement has shown that the number of moving people inside public spaces is associated to some syntactic measures, particularly the strategic value. When 17 variables[49] were analysed with the stepwise regression, the result (Plate 5.18 in Appendix 3) showed that the most significant variable was the strategic value. Interesting to note was the lack of any correlation between the number of moving people and any property associated with convex isovists or the enclosure ratio.

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[49] They are: public space area, isovist area, sum of the length of the isovist (3 methods), mean of the sum of the length of the isovist (3 methods), visibility ratio, enclosure ratio, sum and mean sum of the length of the axial lines, global integration value of the main line, sum of the global integration values of transverse axial lines, strategic value and local strategic value, global integration value of the public space.

Focusing on levels of static occupancy, the first very important finding of this study is that the performance of public spaces does not vary according to users, hour of day or month of year. In addition, the study showed that all the properties which are associated with levels of pedestrian movement are also associated with levels of static occupancy, and properties irrelevant to one are also irrelevant to the other. Likewise for the levels of pedestrian movement, when the same 17 variables are analysed with the stepwise regression for suits (8 am to 4:40 pm, July/August), the most significant one was the local strategic value, as seen in Plate 5.19 in Appendix 3.

As for the number of moving people inside public spaces, the research suggested that the levels of static occupancy is also not a function of public space size, size and length of convex isovists fields or degree of enclosure. The results from the analysis suggested that the configuration of urban fabric in which they are located is the most important property for their performance. Some properties have been investigated and it is suggested that the number of static people deciding to stop in a public space is not only a result of the number of axial lines that interface with the public space, but, most importantly, is also a function of the strategic value. Therefore this results confirm the original findings by Hillier (1984) in so far as the strategic value and levels of static occupation are concerned.

If the performance of public spaces is a function of the strategic value, how do the other properties highlighted in the literature review perform in relation to the current findings?

A closer look at Figure 5.57 which illustrates the relationship between levels of static occupancy and the strategic value (at the beginning of Section 5.2.6) shows three groups of public spaces that have similar patterns of pedestrian use although morphologically they vary substantially. When considering the three most successful urban spaces for number of suits not at pubs, (Fig. 5.57, group "a") two of them are part of the Broadgate Development with similar morphological characteristics. Finsbury Av. and Exchange Square are enclosed public spaces, both have substantial street furniture with plenty of places to sit, and wine bars. On the other hand, they could not be more different to the third most successful public space - Bank Corner. Bank Corner is completely exposed to its surroundings, where the encircling streets show a high level of vehicular movement. There is not a single catering establishment in the vicinity and although it has a good number of seats, it is common to see people sitting on the steps of the Royal Exchange building because there are not enough seats available during the peak period of lunchtime.

The same mixture of elements is found in group "b" (Fig. 5.57), an intermediate group made of Fenchurch Street Station, Love Lane Corner, Royal Exchange and Whittington Gardens; a combination of public spaces with and without catering facilities. Love Lane Corner, like Bank Corner, does not have any catering facilities in the vicinity, it is reasonably exposed but is a very popular destination for City workers. Fenchurch Street, with bad quality street furniture (often very dirty and poorly maintained) is also another popular destination for City workers.

Moving to group "c" (Fig. 5.57), the group that recorded the least number of static people, is composed of Abchurchyard, New Change/Cheapside Corner, North Guildhall and St. Anne & St. Agnes. In Abchurchyard there is a wine bar facing the public space. It is also an enclosed space with building façades opposite entry points. Nevertheless, this public space recorded the smallest number of static people during both the July/August and October periods. Likewise, in Figure 5.60 (Section 5.2.6) when public spaces are compared according to the occupancy levels of all suits, we can identify two, if not more, distinctive groups. Group "a" is composed of Bank Corner, Fenchurch Place, Royal Exchange and Whittington Gardens. Group "b" is composed of New Change/Cheapside Corner, North Guildhall and St. Anne & St. Agnes churchyard, which are all fairly different public spaces as far as the spatial morphology is concerned.

Despite the substantial variation in the level of static occupancy for the selected public spaces, all of them perform well in the context which they are embedded. According to those parameters, the only public space that in fact has a substantially smaller level of static people relative to the strategic value is Fleet Place, as illustrated in Figures 5.57 and 6.60. It is likely that Fleet Place is a case, as pointed out by Whyte (1980), that despite reasonable good levels of pedestrian movement in the nearby streets, the access between public space and street is over elaborated through steep staircases and under buildings canopies.

Although it is accepted that many of the factors discussed by other authors (such as decorative elements, provision of places to sit and relax, and even enclosure that may provide a pleasant feeling for some) can add to the performance of public spaces, so far there has not been any significant evidence that those factors are determinants for the performance of public spaces in the City of London. The analysis showed that in fact, spatial properties, specifically how the public space is embedded in the urban fabric, is the key factor, namely the strategic value.

However, there are discrepancies that have to be explained, particularly the lack of correlation between levels of pedestrian movement inside public spaces and integration values axial lines. It is conjectured that these inconsistencies are related to the fine tuning layout of the public spaces in relation to the urban fabric. This will be addressed in the next chapter. Also, in the next chapter, the second main issue of this thesis will be addressed, that is, which spatial properties affect the distribution of static people inside public spaces.

6

CITY OF LONDON PUBLIC SPACES: PATTERNS OF PEDESTRIAN MOVEMENT AND STATIC OCCUPANCY

This chapter focuses on a detailed examination of the pattern of spatial use of public spaces. Its main objective is to investigate which spatial properties affect the patterns of static occupancy, including the gradual occupation, distribution and preferred locations according to static activities. This chapter also aims to examine the distribution of pedestrian movement inside public spaces and its relationship with static occupancy, as is also pertinent to understanding patterns of spatial use. This chapter is divided into three major sections. The first section looks at patterns of pedestrian movement. The second focuses on patterns of static activity occupancy. Lastly, the results of a survey carried out with public space users are presented, regarding their reasons, frequency and travel distances when using public spaces.

6.1. PATTERNS OF PEDESTRIAN MOVEMENT

It became clear from the analysis in Chapter 5 that pedestrian movement inside public spaces follows a different spatial distribution compared to linear spaces. In linear spaces (that is, the streets) the levels of pedestrian movement correlates well with syntactic measures. Yet, inside public spaces, the pedestrian distribution follows a different spatial logic. The total number of moving people in public spaces correlates well with the strategic value and local strategic value, but no correlation could be found between individual axial lines and the respective recorded number of moving people.

Although the overall level of pedestrian flow corresponds well with the proposed effective routes axial model[1], an analysis of pedestrian distribution indicates that once people have arrived at a public space, pedestrian movement does not necessarily follow the most direct visual and permeable links. Although all selected spaces are fairly unobstructed areas in terms of their internal configuration, in that they are relatively open and permeable with easy access to the surrounding grid, it was observed that on many occasions pedestrians tended to go around the public space rather than to walk directly across it, even though a potential "short cut" route was available.

The aim of this section is therefore to examine the mechanisms that operate on the decision-making process regarding people's choices of pedestrian routes in and around public spaces. Specifically, the issue of whether preferable routes for pedestrian movement are related to the internal spatial complexity of the public spaces will be examined; that is, to fixed elements such as the location of seats, decorative elements, split levels, or in fact whether they are related to the location of static people. Hence, the apparent dichotomy between short but complex routes, where the pedestrian has to negotiate his way around a sequence of physical elements, and longer but effortless, generally peripheral routes, will be analysed.

The numerical analysis presented in Chapter 5 has provided us with information on the levels of moving people inside the public spaces. However, only by directly tracing the pedestrian routes through the space can one obtain quantitative and qualitative information on preferential pedestrian routes as well as to what extent the recorded number of moving people inside public spaces is related to "through" or "to" movement. It is conjectured that "through" movement is related to the level of integration of the public space in relation to the natural pedestrian routes in the area, whereas "to" movement may be related to the percentage of pedestrian movement inside the public space that is in fact aimed towards specific destinations, such as office buildings or wine bars. Once the density of the "through" movement is known, it will be possible to investigate which spatial factors or other constraints, if any, deter people from walking through the spaces and encourage them to select alternative

[1] See Section 5.1.3 in Chapter 5.

routes. In addition, it will be feasible to investigate if there is a diurnal pattern for pedestrian routes. If there is a diurnal pattern, the location of static people may be a key element, since it is the only element that varies with time. If there is not a diurnal pattern, the internal spatial complexity might be the controlling factor. These two factors will therefore be investigated.

6.1.1. FIELD WORK

In order to obtain a proportional representation of the distribution of pedestrian routes in the area, the number of people followed was derived from the number of people previously counted with the gate methodology[2]. The number of people followed was 0.5% of the mean hourly rate recorded during the gates observation. Therefore not only is it possible to compare the patterns of pedestrian movement for the different locations in and around each public space but also amongst the twelve areas[3].

People were followed within the catchment area defined for each open space, during three time periods: the early morning peak from 8:00 - 9:20 am (going to work), the lunchtime from 12:00 - 2:10 pm and the early evening peak from 4:50 - 6:10 pm (leaving work)[4]. Like for the gates methodology, only people from the "suits" category were followed, and the number of men and women was randomly selected. The pedestrians' routes were recorded by tracing their itinerary on a map of the City of London, starting from the outside gates of each catchment area. This meant that the number of people to be followed for the inside gates (according to the level of pedestrian movement of each gate) were naturally and automatically recorded as people were followed along their chosen route.

The data (Plate 6.1, next two pages) is shown initially as a summary overlay of all the pedestrian activity in and around all public spaces throughout the day.

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[2] See Section 5.1.1 in Chapter 5.

[3] Also, this methodology avoids misleading information, as single short orientated routes with low levels of pedestrian movement can graphically appear to be busier compared to long diverse ones, when the data is collected based either on time or people are randomly followed within the catchment area.

[4] The data was collected from 10th to 24th September 1996, one day per public space or longer when necessary. Generally, it was possible to follow the established number of moving people within the time period. When this was not possible due to the sheer number of people to follow, (like the Bank area during peak hours) or long distances to be covered (as is the case of the two public spaces of the Broadgate development) part of the data collection was carried out on a second, consecutive, day.

Plate 6.1. Pattern of pedestrian movement inside public spaces (1/2)

all day

scale: 1:2500

"through" movement
"to" movement
"generic" movement

Fig. 1. Abchurchyard

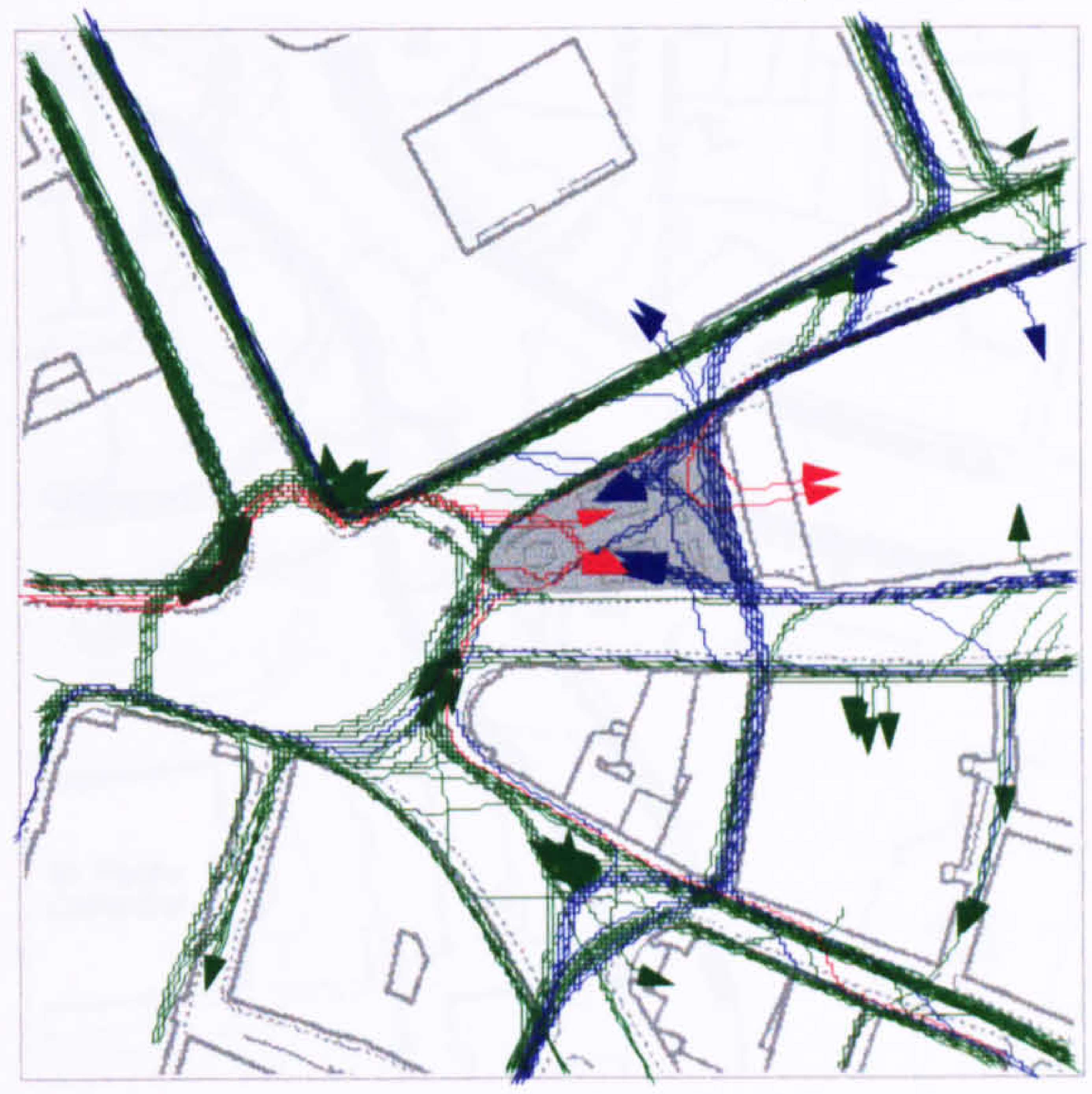

Fig. 2. Bank Corner

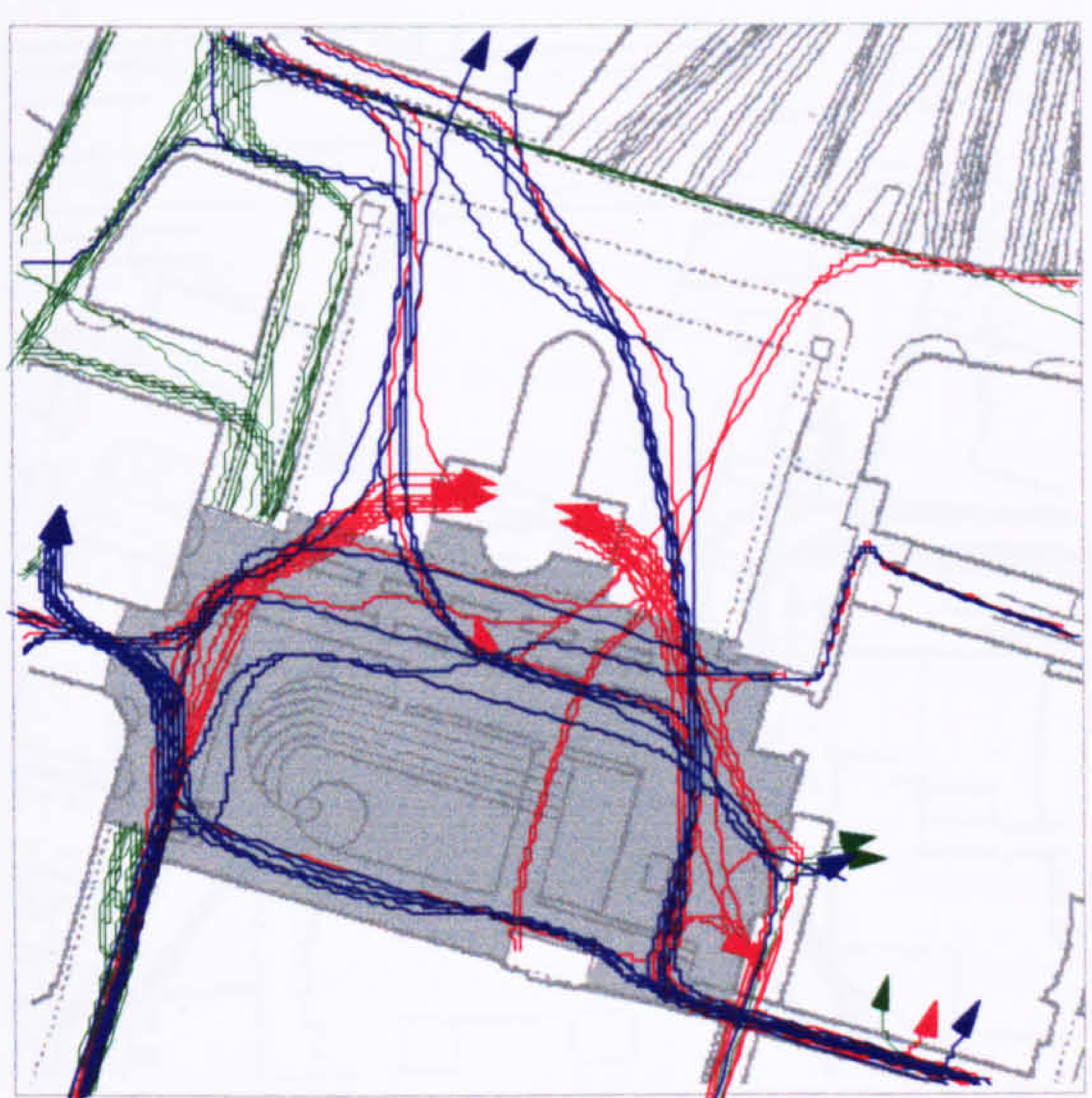

Fig. 3. Exchange Square

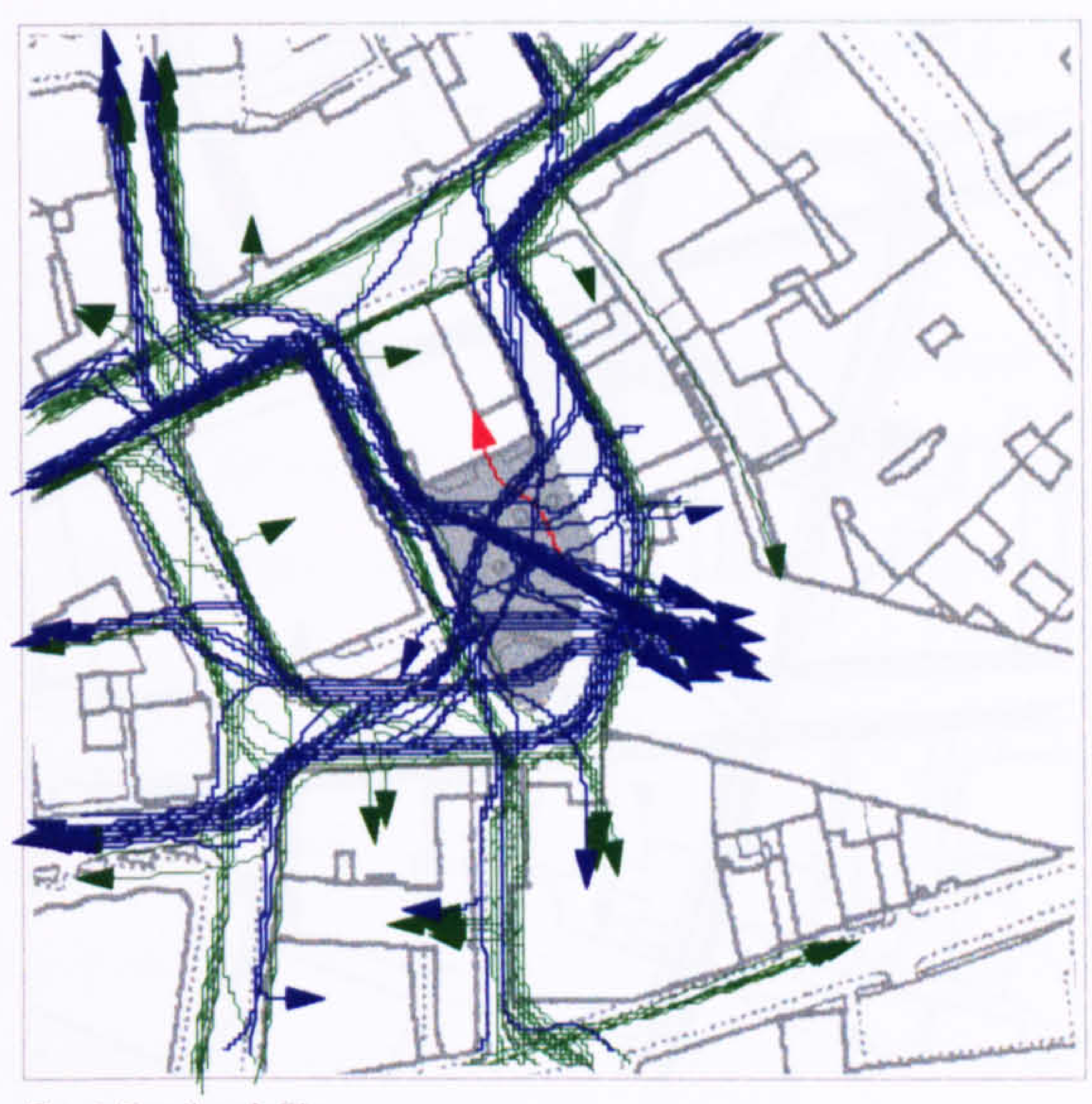

Fig. 4. Fenchurch Place

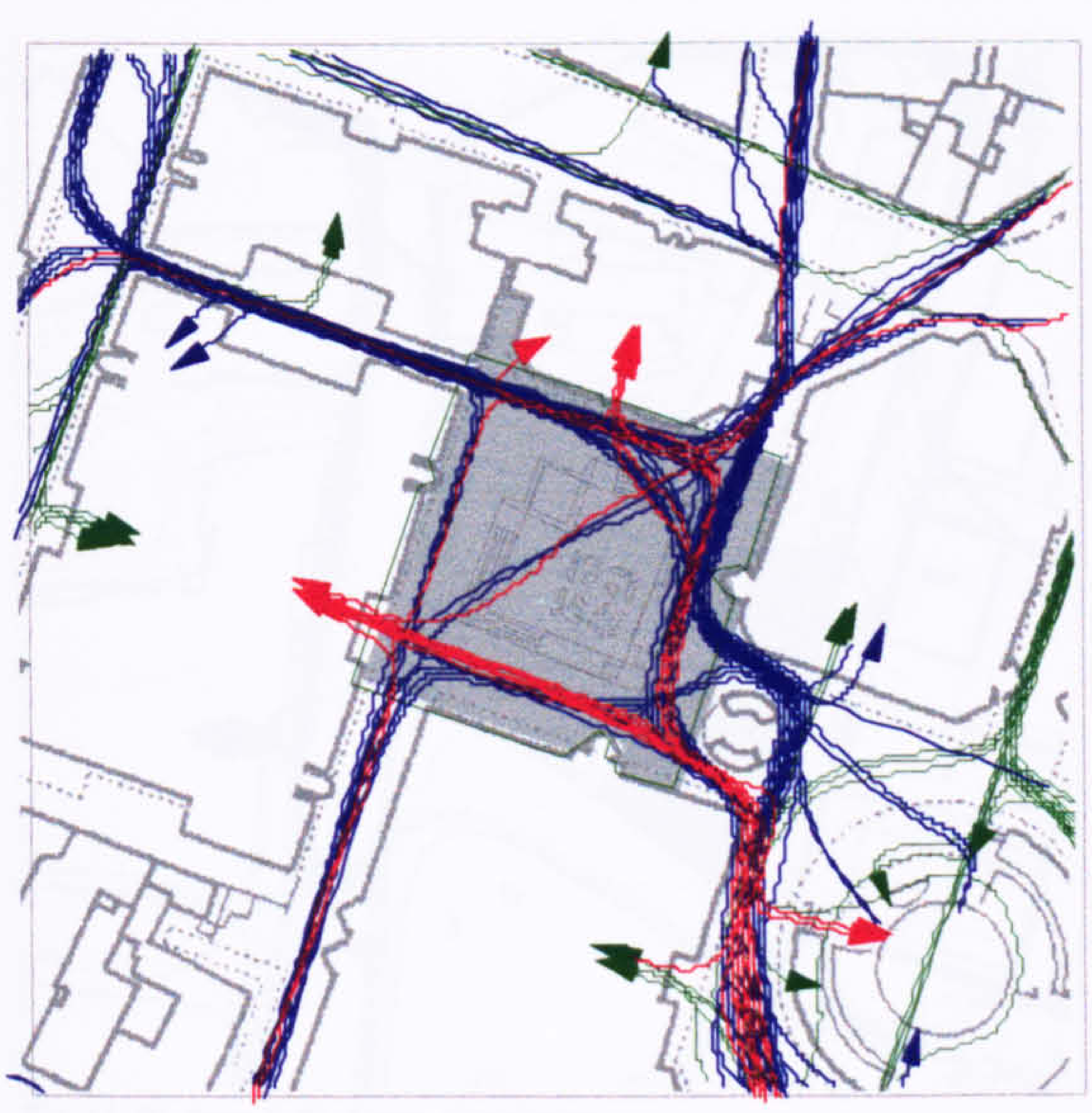

Fig. 5. Finsbury Av.

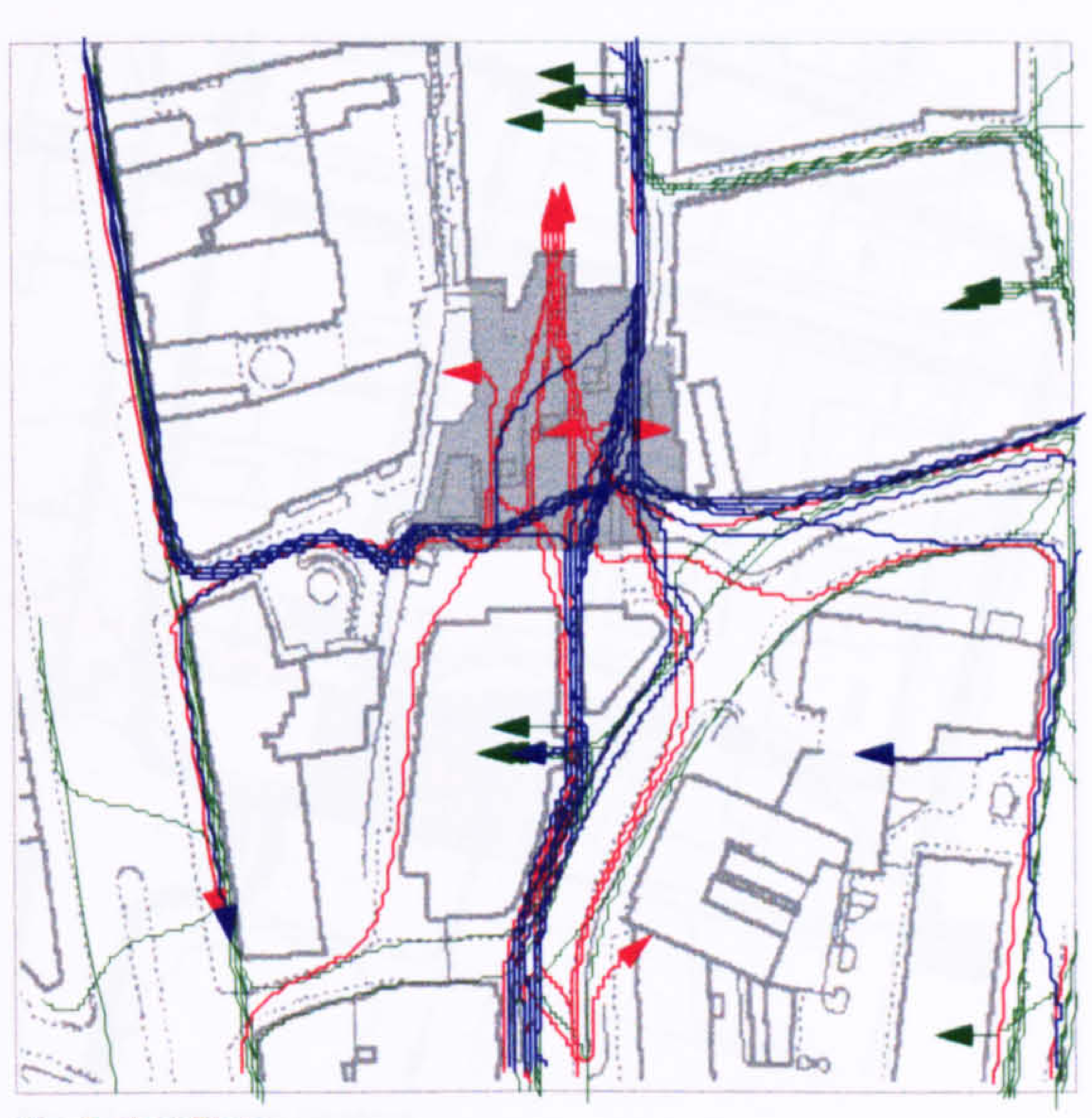

Fig. 6. Fleet Place

Plate 6.1. Pattern of pedestrian movement inside public spaces (2/2)

scale: 1:2500

all day

"through" movement

"to" movement

"generic" movement


Fig. 7. Love Lane Corner

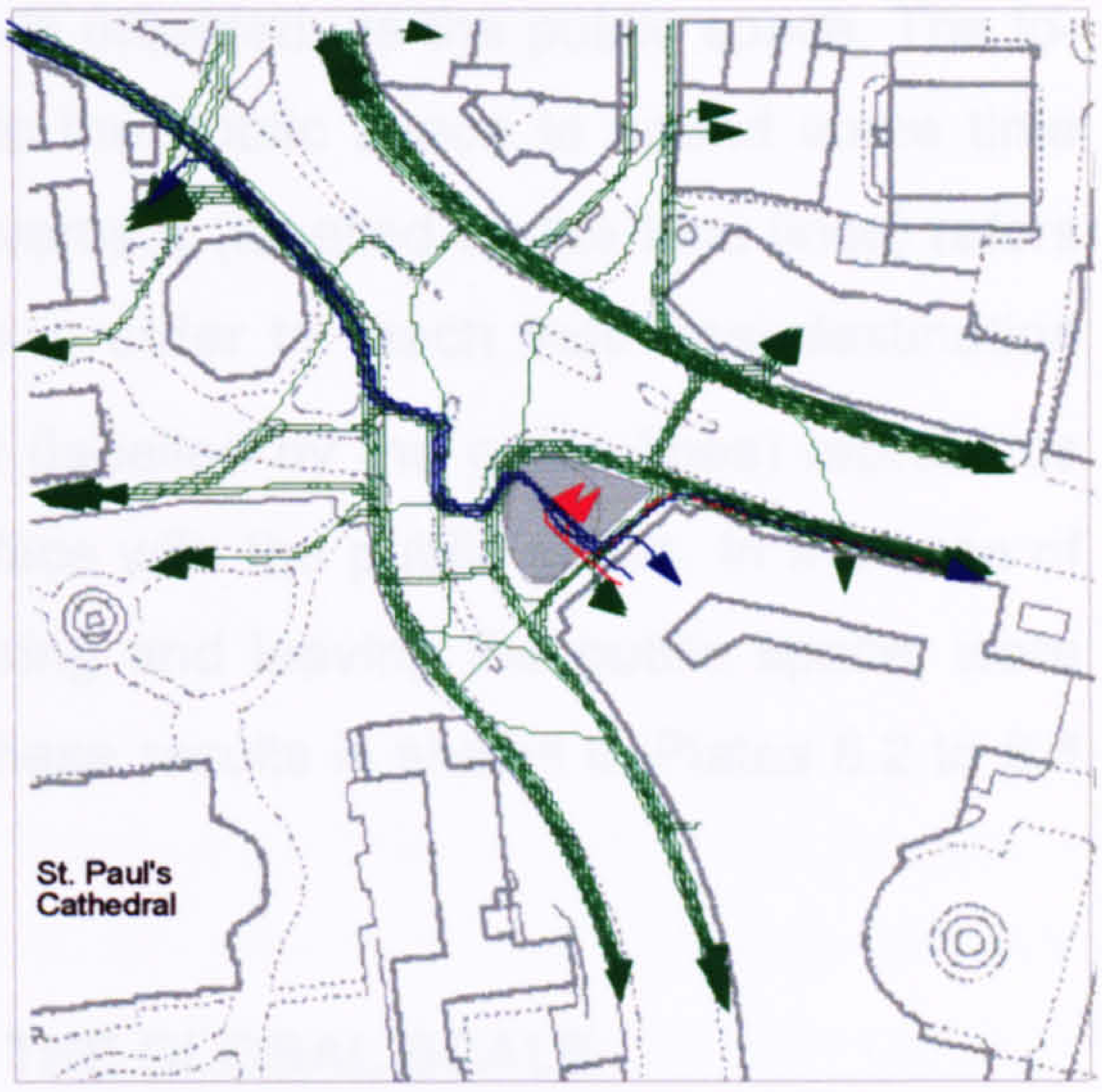

Fig. 8. New Change/Cheapside Corner


Fig. 9. North Guildhall

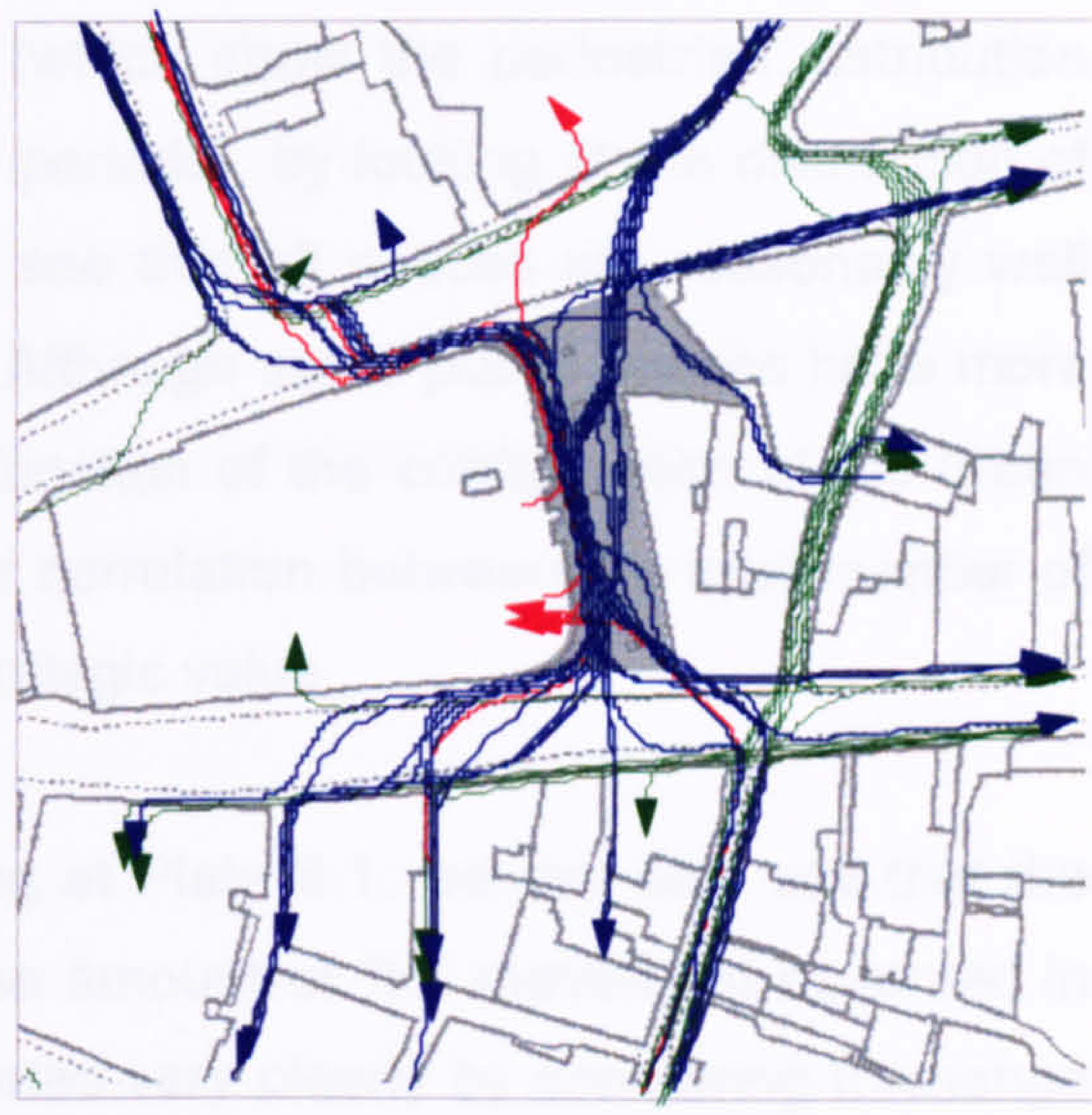
Fig. 10. Royal Exchange


Fig. 11. St. Anne & St. Agnes churchyard


Fig. 12. Whittington Gardens

The pedestrian movement has been defined according to three different categories. The "to" movement (labelled by the red lines) involves movement through the public space but towards a building to which access is provided via the public space. The to-movement also includes people who come to the public space to spend some time engaged in static activities. The "through" movement (labelled by the blue lines) refers to any person who crosses the public space in order to reach their final destination outside the space[5]. The "generic" movement (labelled by the green lines) represents any pedestrian movement that does not interface with the public space. In the case of "to" movement, both directions, that is, entering and leaving the public space, were considered. A larger scale representation of these results is shown in Plates 6.2 to 6.8 in Appendix 4.

6.1.2. PEDESTRIAN MOVEMENT ON THE GLOBAL SCALE

Examining Plates 6.2 to 6.8 in Appendix 4 (which show the pedestrian distribution across the sample according to different time periods), by looking at the distribution of pedestrian lines in the urban fabric, we can see that all spaces are reasonably well embedded in the urban structure of the City. Although some public spaces have more people crossing them than others, this is a function of the configuration of the urban grid, as previously seen by the positive linear correlation between the total number of moving people inside public spaces and the strategic value.

However, re-examining the results, by looking at Plate 6.1, we can also see that the sample is very heterogeneous in terms of the amount of "to" movement observed in relation to "through" movement. This is illustrated very clearly by comparing Exchange Square and Fenchurch Place. In the case of Fenchurch Place (Fig. 4, Plate 6.1) we can see that there is a high density of "through" movement represented by the diagonal blue lines crossing the space, conversely, levels of "to" movement are very low. Whereas for Exchange Square (Fig. 3, Plate 6.1), there is a much lower level of "through" movement compared to "to" movement, and most of it is restricted to the peripheric south side of the space. The results are summarised in Table 6.1, where the number of "to" and "through" movement represents the number of people that were followed.

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[5] Access to underground or train stations is considered through movement.

Public space name	number of "to" movement	number of "through" movement	% "through" movement in relation to total movement
Abchurchyard	4	1	20
Bank Corner	7	10	59
Exchange Square	37	30	45
Fenchurch Place	1	47	98
Finsbury Av.	22	66	75
Fleet Place	14	14	50
Love Lane Corner	3	5	63
New Change	2	3	60
North Guildhall	7	11	61
Royal Exchange	5	23	82
St. Anne	0	1	100
Whittington Gds.	2	12	86
MEAN ALL CASES	8.66	18.58	68

Table 6.1: Number of "to" and "through" pedestrian movements

Previously in Chapter 5, the data showed that levels of pedestrian movement could not be related to the individual integration values of the axial lines that interface with the public space. In the above analysis, it was not possible to pinpoint what proportion of pedestrian movement was associated with "to" and "through" movement. However, a qualitative indication of this ratio can be obtained from the data presented in Plate 6.1. The percentage of "to" and "through" movement was multiplied by the hourly recorded mean number of moving people inside public spaces (Refer to Tables 5.1 and 5.2 in Appendix 3). The results give a "to" and "through" rate of hourly pedestrian movement. The "to" and "through" hourly movement rates were then individually correlated against the strategic value of each space, with important results.

The mean number of "to" movement correlates well with the strategic value, as seen in Figure 6.1; better than when total movement was used (Fig. 6.2)[6], as seen by the more linear distribution of points. However, when looking at the mean number of "through" movement, only a very weak correlation was found between the two variables as shown in Figure 6.3.

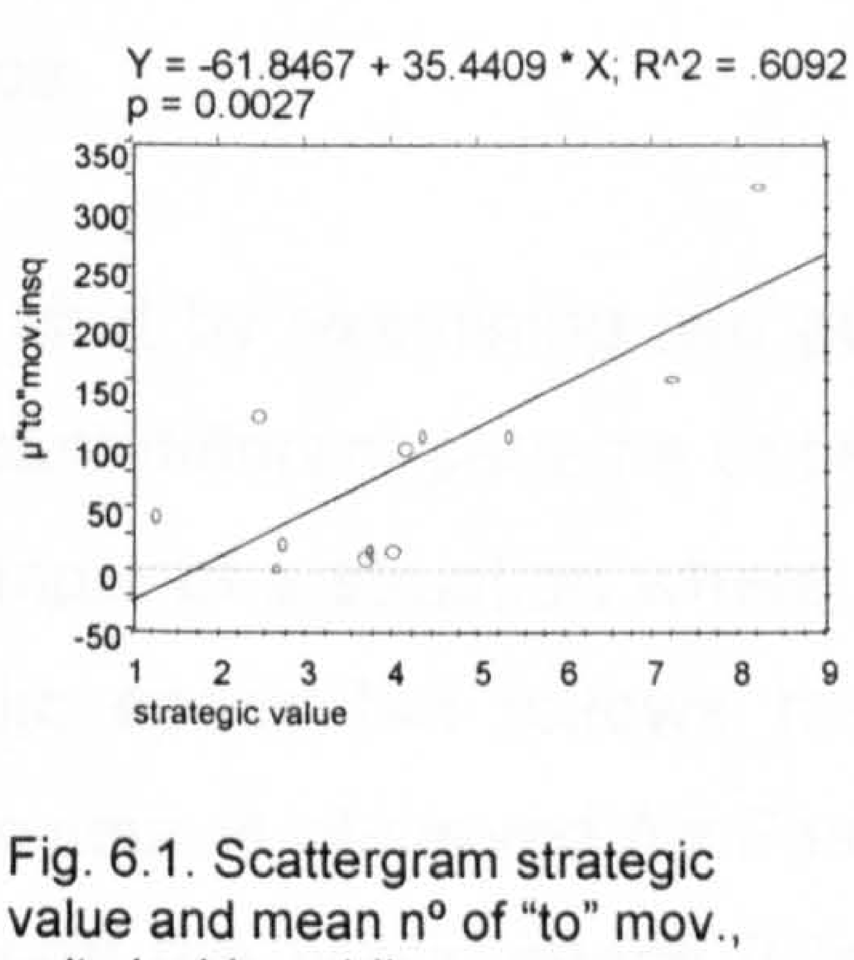


Fig. 6.1. Scattergram strategic value and mean nº of "to" mov., suits inside public spaces

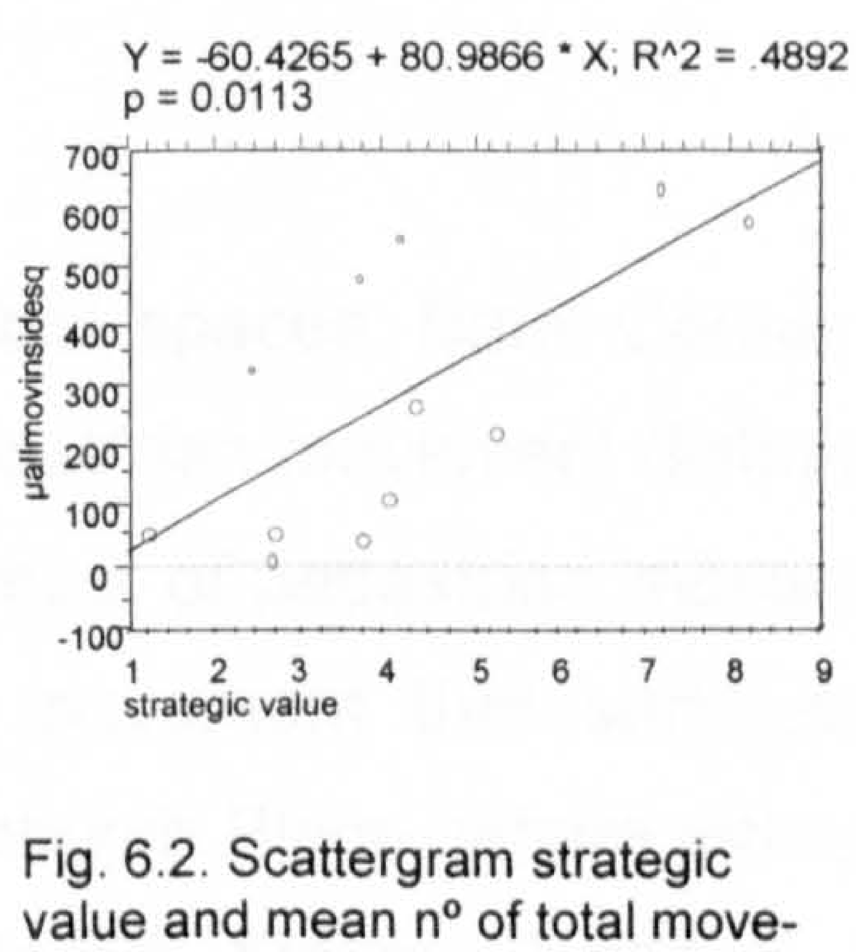


Fig. 6.2. Scattergram strategic value and mean nº of total movement -suits inside public spaces

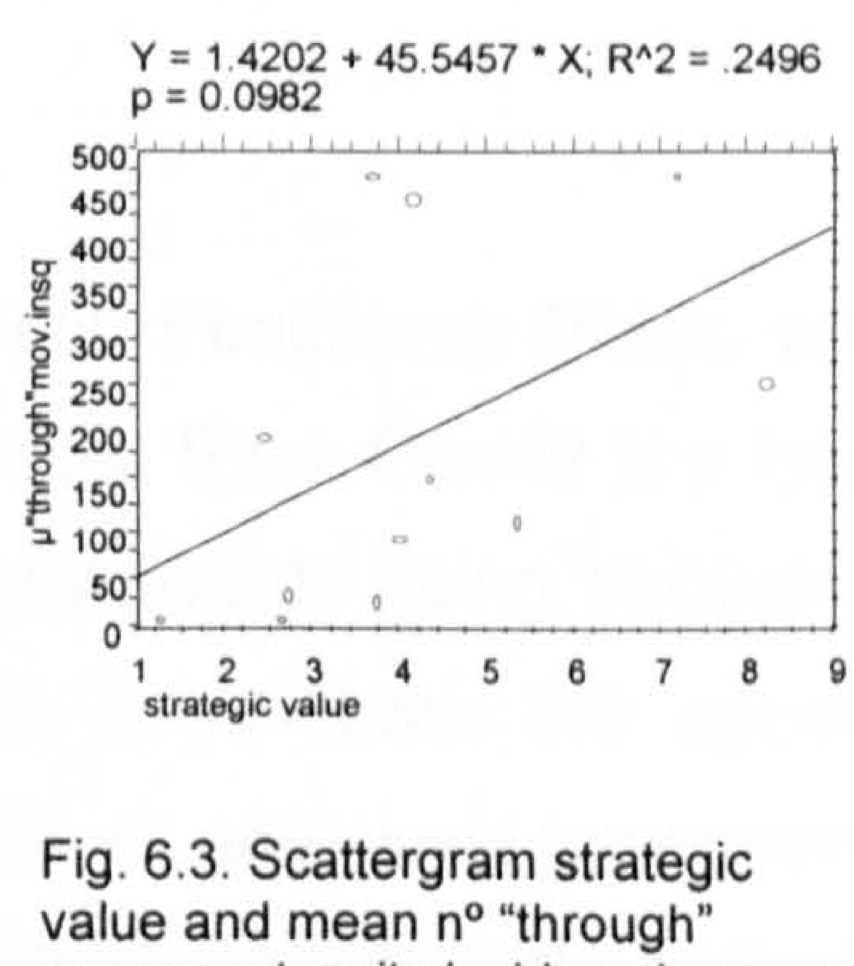


Fig. 6.3. Scattergram strategic value and mean nº "through" movement, suits inside pub. spaces

6 As previously discussed in Chapter 5. See Figure 5.36.

From these results, it could be argued that the levels of "to" movement as well as of static people (Chapter 5) are a function of the strategic value. The key issue for understanding pedestrian distribution inside public spaces, however, is related to "through" movement. City workers, on arrival at the public space through the global properties of the urban fabric, prioritise certain routes. It is suggested that the relationship between visibility and permeability is an essential feature of such behaviour. This will be examined next.

6.1.3. PEDESTRIAN MOVEMENT ON THE LOCAL SCALE

The investigation of local scale pedestrian movement will initially be divided according to time periods. It is aimed firstly to investigate whether the pattern of pedestrian distribution is different according to the time of day. It is suggested that, if there is a diurnal pattern of pedestrian distribution, then this is likely to be related to the level of static occupancy, which is the only element that varies throughout the day, and which will be discussed in Section 6.1.3.1. If this is not the case, the pedestrian distribution might be a result of the internal spatial complexity of the public space in relation to the potential cross movement, discussed in Section 6.1.3.2.

6.1.3.1. Through movement and diurnal patterns

To investigate whether pedestrian distribution follows a diurnal pattern, the data is analysed according to the three time periods when the observations were carried out. The morning peak period has high movement rates but low levels of static occupancy. The lunchtime period has high levels of movement and static occupancy, and the early afternoon peak has high levels of pedestrian movement and low or medium levels of static occupancy, depending on whether there is a wine bar in the vicinity of the public space.

We start by examining two public spaces, Bank Corner and Fenchurch Place, which present different patterns of pedestrian movement distribution. Bank Corner is a typical example of a situation where most of pedestrian movement avoids going through the public space but follows the pavement that surrounds it, whereas the opposite behaviour is observed for Fenchurch Place, where virtually all east-west movement is through the public space (Plate 6.1, Figures 2 and 4). This is particularly intriguing, since both spaces present similar spatial characteristics, notably their size and enclosure ratio. Both places are at street level and are surrounded by vehicular movement. Also, both resemble a triangular shape, with one side constituted by a building façade. The key pertinent characteristics are summarised for the two public spaces in Table 6.2.

Properties	Bank Corner	Fenchurch Place	Mean all 12 cases
Area (m^2)	1019.85	830.98	1593.41
Perimeter (m)	138.03	118.24	173.75
Enclosure ratio	0.59	0.22	1.73
Spatial form	triangle shape	triangle shape	not applicable
At street level	yes	yes	not applicable
Presence of vehicular movement	yes	yes	not applicable
Intensity of vehicular movement	high	low	not applicable
Presence wine bars	no	yes	not applicable
Mean suits static (July data)	17.79	16.70	25.80
Mean nº people moving inside/hour	264.67	480.67	350.06
Mean nº people moving outside/hour	1389.56	928.31	727.62
Ratio moving outside/inside	5.2	1.9	7.76
Ratio "through" and "to" movement	1.42	47	5.74

Table 6.2. Comparative measures for two selected cases

Figures 6.4 and 6.5 illustrate pedestrian distribution according to the different time periods for Bank Corner and Fenchurch Place. The "through" movement is highlighted in blue for a clearer picture, whereas both "to" and "generic" movements are coloured in grey.

Figure 6.4. Pattern of pedestrian distribution, through movement, according to time periods for Bank Corner

Figure 6.5. Pattern of pedestrian distribution, through movement, according to time periods for Fenchurch Place

Figures 6.4 and 6.5 show that the distribution of moving people inside the public spaces does follow a diurnal pattern. There are more people crossing the public spaces during lunchtime period compared to early morning and afternoon peak times (refer to Figures 5.1 and 5.78 in Chapter 5), although the overall levels of pedestrian movement are comparable for the three time periods. Yet, the distribution of pedestrian movement is quite different. During the lunchtime period, pedestrian movement tends to be scattered rather than restricted to one or two singular routes as observed for the other two time periods. In fact, as discussed previously, the pattern of movement in the City of London during rush hours is very directional towards the main transport nodes (as illustrated very clearly in Plates 6.2 to 6.8 in Appendix 4)[7]. For the lunchtime period, City workers pursue a more local, explorative pattern, engaging themselves in all sorts of activities including going for a short walk, visiting the local bank or buying food at the local sandwich shops. The dispersal of the "through" movement inside public spaces occurs exactly during the lunchtime period, when the highest number of static occupancy occurs.

Considering the results from the two public spaces (Figs. 6.4 and 6.5), it appears that the amount of people deciding to avoid crossing the space is not related to the time of day, as a function of the level of static occupancy. If this was a function of the level of static occupancy, then the dispersal of people crossing the public spaces would be at its lowest value during lunchtime. In fact, the reverse situation is found.

It is suggested that the reason for people crossing or not crossing public spaces towards their destination is likely to be related to their internal spatial complexity. In the same public space, certain areas are prioritised against others, as seems to be the case with Bank Corner. In order to explore this issue, the pattern of pedestrian distribution for Bank Corner and Fenchurch Place will be analysed according to points of entry.

6.1.3.2. Through movement and points of entry

We can use the same two previous examples to study the difference in movement potentials across public spaces as a function of the internal spatial complexity. Figures 6.6 and 6.7 show the dispersal of pedestrian movement (highlighted in blue) according to the points of entry (highlighted in red) for Bank Corner and Fenchurch Place. In

[7] This pattern has also been observed in Hillier's (1984) study on the Mansion House Square.

these examples, the "to" and "generic" movement has been omitted for a clearer picture of the pedestrian distribution. The numbers in Figures 6.6 and 6.7 represent the amount of people followed, and the numbers in brackets represent the value of routes segments.

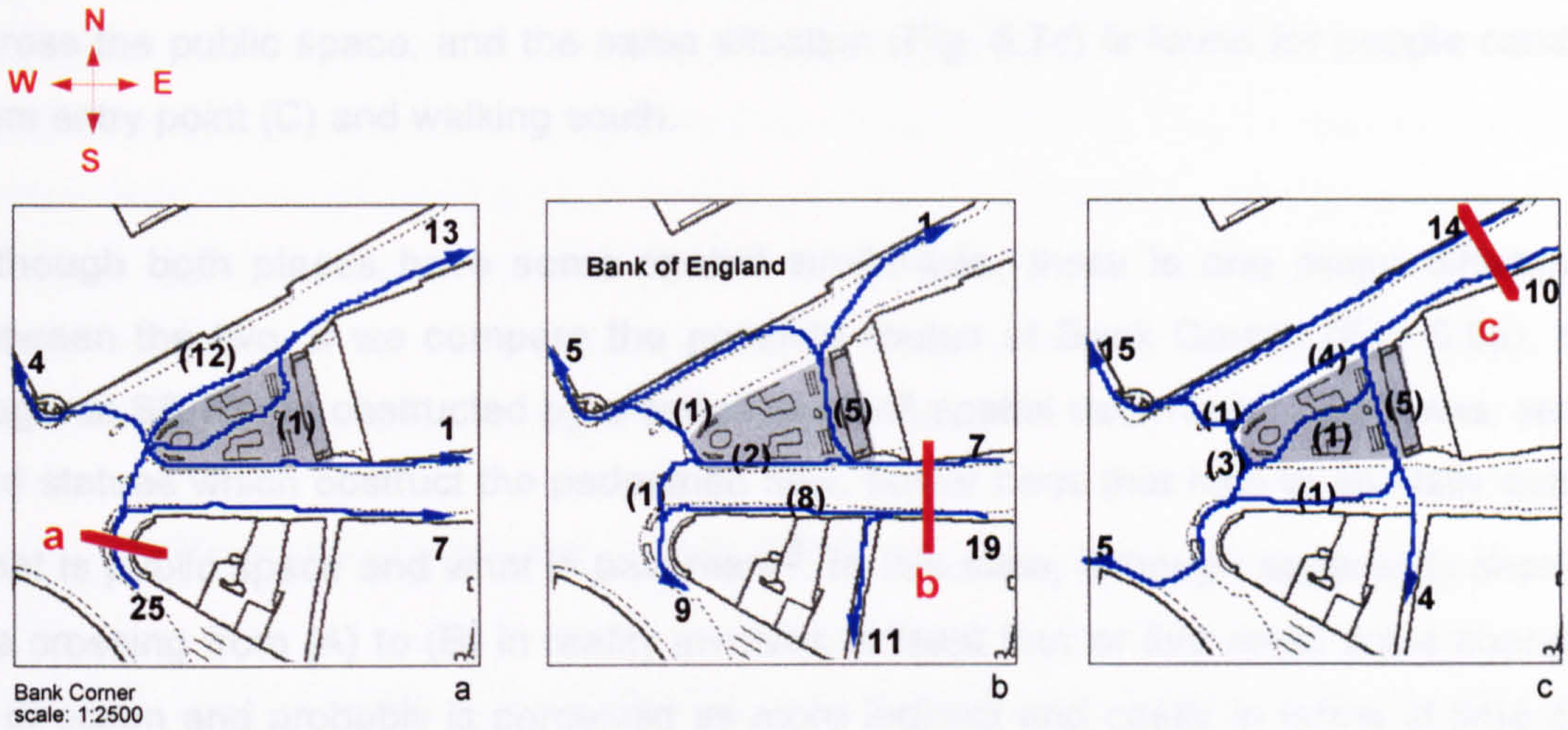


Figure 6.6. Pattern of pedestrian distribution according to entry gates for Bank Corner (all day)

On examination of Figure 6.6a, from a total of 13 people walking from SW to NE, only 1 person crosses (8% of all) the public space while the remaining 12 City workers choose to go around it. In Figure 6.6b considering all people going from the SE to NW, not one single person uses the potential diagonal route. From 6 people walking towards the Bank of England, 5 decide to cross by the steps of the Royal Exchange building and 1 person decides to walk around the public space. In Figure 6.6c, of the 10 people accessing the public space from the north, 5 arrive at the SW destination. Of these 5, 1 person only (20%) walks across the public space via the diagonal route, 3 (60%) circumnavigate the area and 1 person (20%) takes the direct route down the public space and then turns right to the west side.

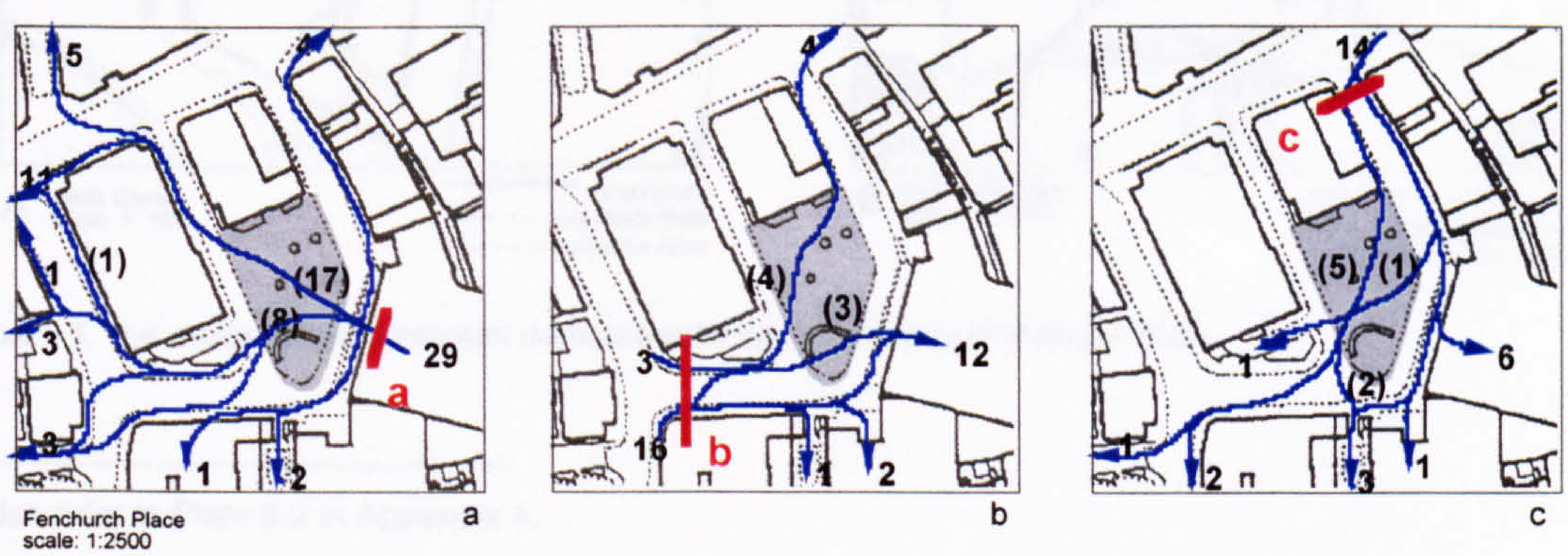
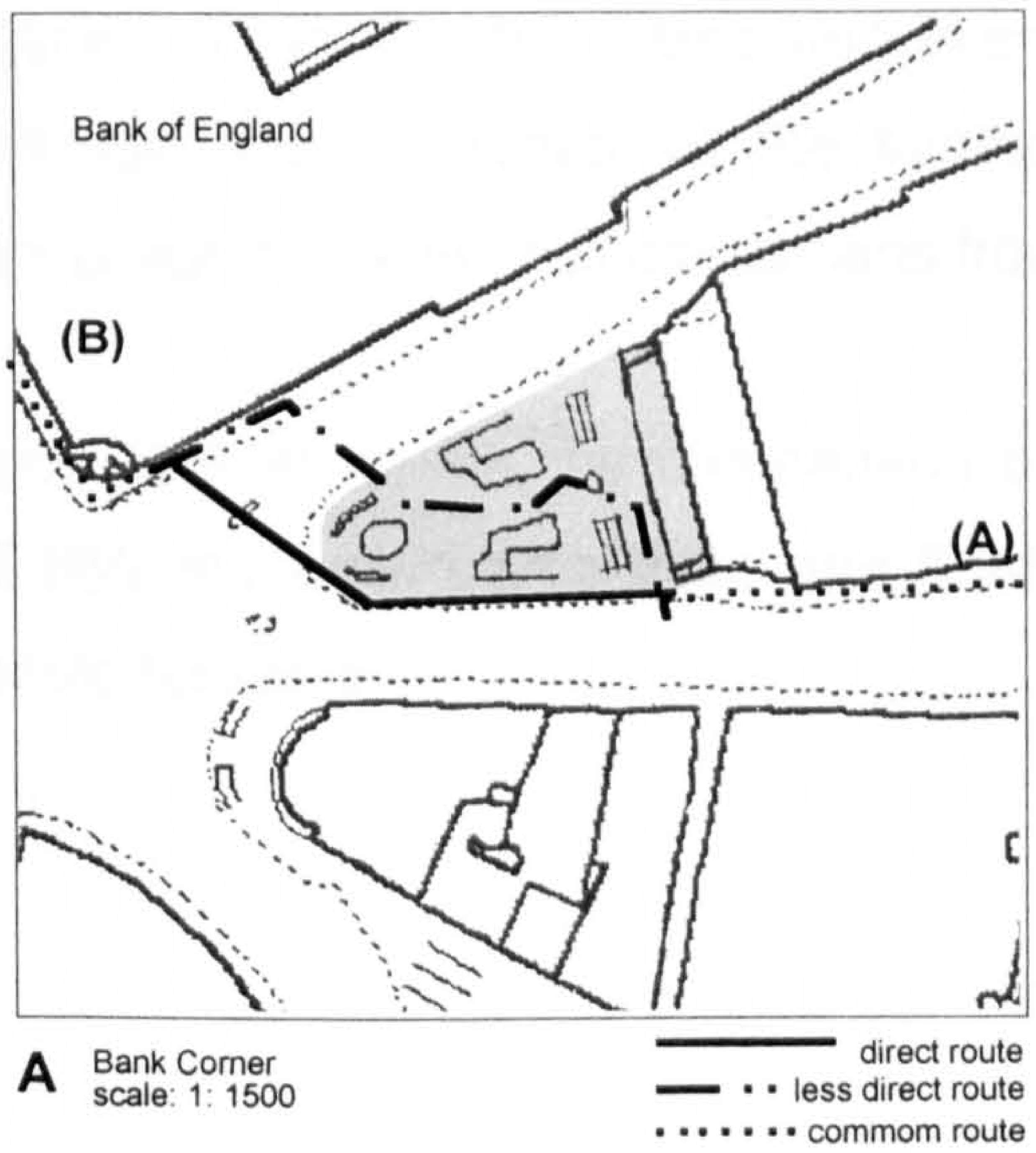


Figure 6.7. Pattern of pedestrian distribution according to entry gates for Fenchurch Place (all day)
Obs. The numbers between brackets represent the number of people for individual segments

In contrast, Fenchurch Place has a completely different character, although in principle, both places have similar shapes and visual accessibility from the immediate surrounding grid. Of the 8 people leaving Fenchurch Train Station, going west, as illustrated in Figure 6.7a, all pedestrians decided to cross the public space. The same pattern is found in Figure 6.7b where 4 people walking from SW to NE chose to walk across the public space, and the same situation (Fig. 6.7c) is found for people coming from entry point (C) and walking south.

Although both places have some spatial similarities, there is one major difference between the two. If we compare the possible routes at Bank Corner (Fig. 6.8a), the diagonal SE-NW is obstructed by a series of small spatial deterrents: split levels, seats and statues which obstruct the pedestrian flow, flower beds that help to spatially define what is public space and what is pavement[8]. In this case, although apparently shorter, the crossing from (A) to (B) in reality involves at least four or five small scale changes of direction and probably is perceived as more indirect and costly in terms of time and effort than the peripheral option. Therefore, it seems that in this particular case it is less arduous to keep walking along the surrounding pavement than to take the visually shorter diagonal route[9]. Bank Corner is widely visible, but in real terms it is not widely accessible. Bank Corner can be characterised as exhibiting "contour route behaviour".



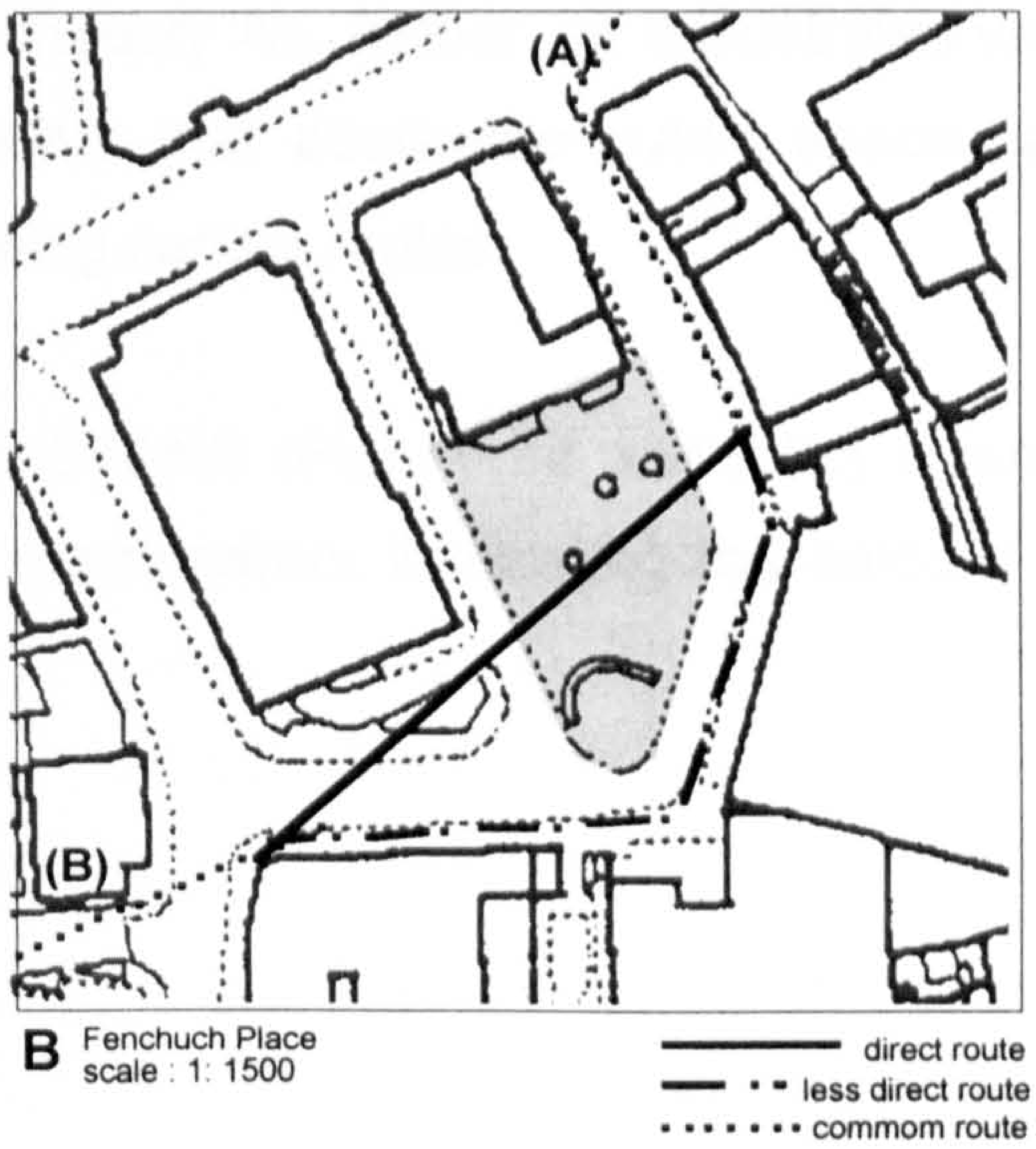


Figure 6.8. The choice of routes between destinations for Bank Corner and Fenchurch Place

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[8] Also refer to Plate 6.2 in Appendix 4.

[9] Conversely, the North-South link is unobstructed, and consequently is heavily used as the major connector for people walking between Cannon Street and the Bank of England. Refer to Plate 6.1.

In contrast, in Fenchurch Place the diagonal route is unobstructed. Trees and seats have being carefully positioned, consciously or unconsciously, leaving the potential diagonal route free of any obstacles (Fig. 6.8b)[10]. There are no split-level areas, flowerbeds or small walls that create a permeability barrier between the public space and the surrounding pavement. As discussed previously in the morphological study of traditional urban squares, at Fenchurch Place, the physical distinction between public space and street is minimal. Comparing the direct (straight line) to less direct route (dotted line), it becomes very clear how much more an individual has to walk to arrive at his destination if he is to walk around the public space. Fenchurch Place is not widely visible but is widely accessible. Fenchurch Place, therefore, can be characterised as exhibiting a "diagonal route behaviour".

6.1.3.3. Through movement: the twelve cases

Four other public spaces also exhibit the "contour route behaviour". They are Finsbury Av., Love Lane Corner, New Change/Cheapside Corner and St. Anne & St Agnes churchyard, as illustrated in Plate 6.1. New Change/Cheapside Corner is a blueprint for the pattern of pedestrian distribution previously described for Bank Corner. The vast majority of pedestrian movement (83%) from St. Paul's Cathedral towards Cheapside deviates to the adjacent pavement surrounding the public space, as illustrated in Figure 8, Plate 6.1. It is interesting to inspect Finsbury Av. further, as it illustrates very well how the fine-tuning of the spatial elements that adorn the public space can encourage or discourage pedestrians from following certain routes.

Figure 6.9 illustrates the comparison between SW-NE (Figs. 6.9a and 6.9c) against SE-NW movement (Fig. 6.9b and 6.9d) with the numbers illustrating the amount of people followed.

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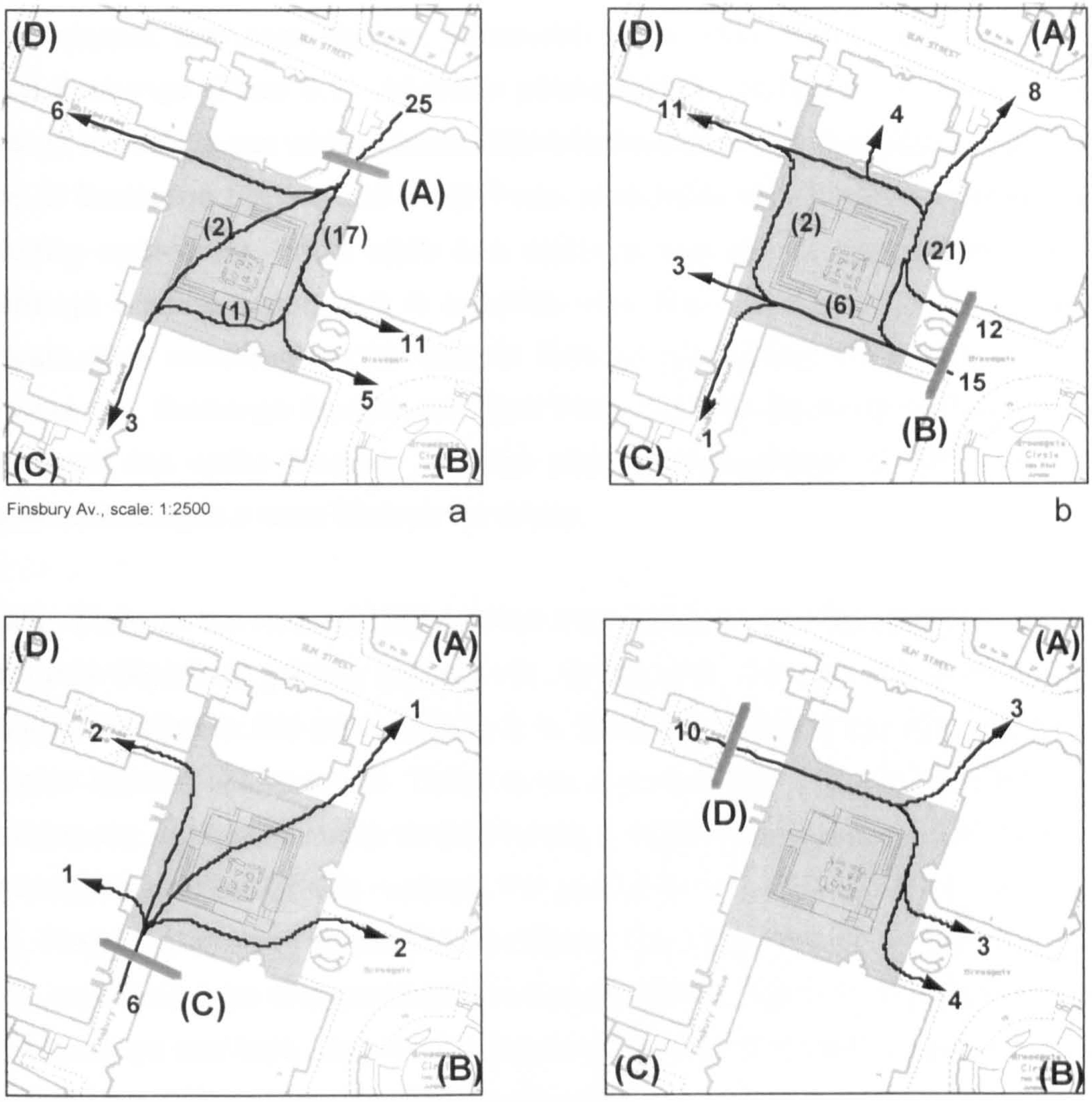
[10] Also refer to Plate 6.3 in Appendix 4.



Finsbury Av., scale: 1:2500 a b

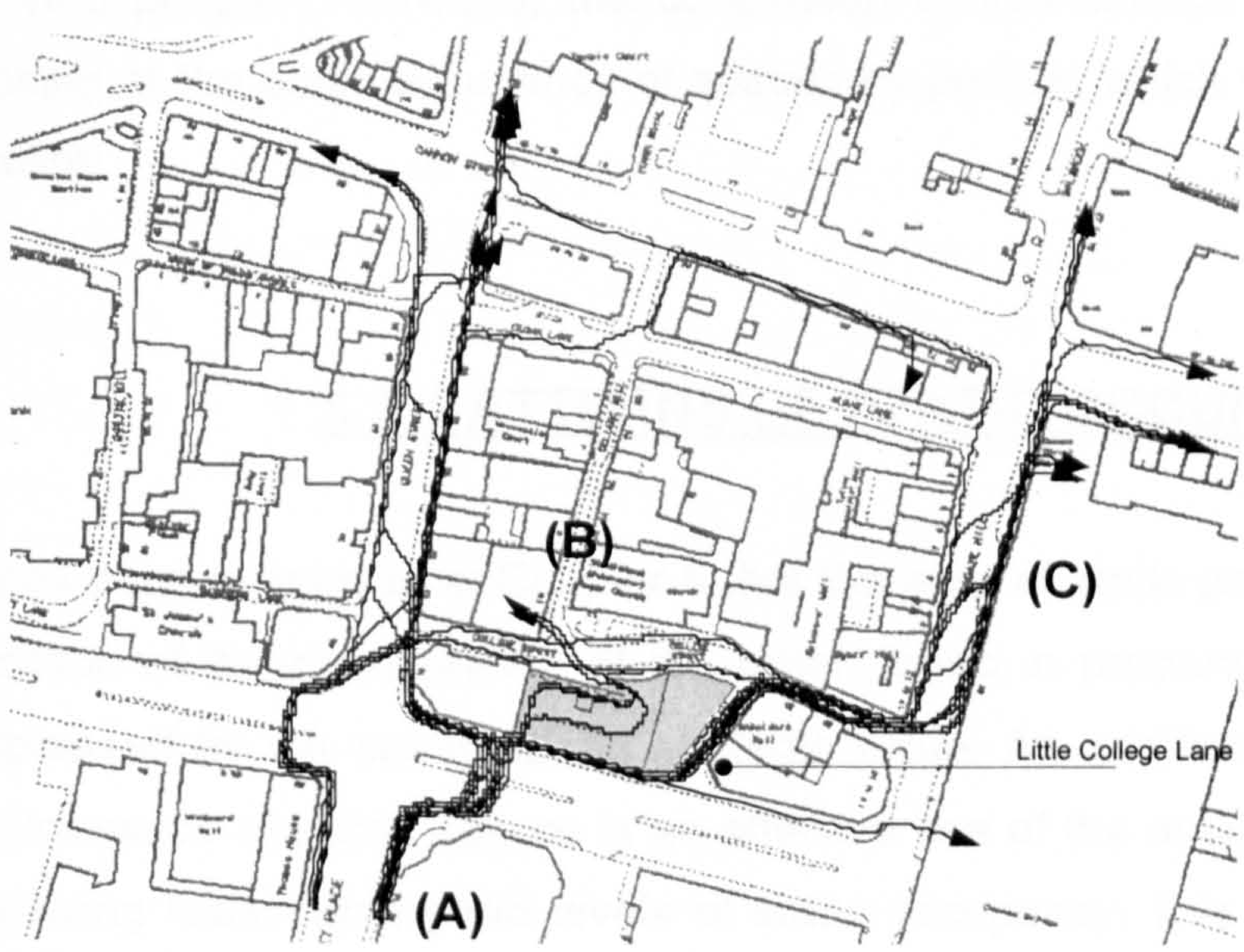
Finsbury Av., scale: 1:2500 c d

Figure 6.9. Pattern of pedestrian distribution according to entry gates: Finsbury Av. (all day) - 2/2
Obs. The numbers between brackets represent the number of people for individual segments

On examining Figure 6.9a, it is clear that 67% of the City workers that went from (A) to (C) decided to cross the public space following the diagonal route. From (C) to (A) the one person followed took the diagonal route (Fig. 6.9c). When we compare the east and west link (Fig. 6.9b), although there are some steps which connect the inner centre of the public space to the surroundings, the seats which are in fact obstructing the route (refer to Plate 4.5 in Appendix 2) are a major deterrent. Not one single person, of the 21 who took the route, was observed crossing the space. Instead, people diverted around its edges. Hence, the diagonal route is seen as a potential route in the global structure of the City of London, but broken up at the micro level. Like Bank Corner, part of pedestrian movement is being diverted to adjacent areas because, although there is a powerful visual link, the permeability link is lost.

There is a second group of six public spaces which exhibit "diagonal route behaviour": Abchurchyard, Exchange Square, Fenchurch Place, Fleet Place, North Guildhall and Royal Exchange (Plate 6.1). All these public spaces, except for Exchange Square, have an internal layout which causes little interference to the pedestrian routes. In the case of Exchange Square and Fleet Place, both have sophisticated internal layouts, including split-levels, short walls and seats at the central core of the space. In Exchange Square, mainly due to its sheer size, the effective routes are reasonably unobstructed, encouraging the natural flow of pedestrian movement. Similar to Finsbury Av., Exchange Square and Fleet Place are also disconnected from vehicular movement, but unlike Finsbury Av., the internal configuration of both these public spaces encourages a route through the space.

Finally, there is the one remaining case that does not belong to either of the two previously described generic groups, viz., Whittington Gardens. Primarily, due to its strategic location in the urban fabric, it is used as a transitional space, despite its complex internal configuration. There is no diversion, like we saw for Bank Corner, because any alternative route would involve a much longer journey and therefore is generally disregarded by City workers. For people coming from Southwark Bridge (Fig. 6.10, Position (A)) along Upper Thames Street, the public space is used as a through route, especially if the final destination is College Street (Fig. 6.10, Position (B)) with its office buildings and bars. Only for individuals going east (Fig. 6.10, Position (C)), is the route via Little College Lane the most likely option.



Whittington Gardens, scale: 1:3000

Figure 6.10. Pattern of pedestrian distribution from Southwark Bridge: Whittington Gardens

To summarise, the analysis revealed that although visual properties are essential for the general pattern of pedestrian movement, the fine-tuned connection between public spaces and the surrounding urban fabric, associated to their internal built form, is essential for good levels of through movement. Public spaces in which the street furniture is well organise in relation to internal effective routes are more likely to be used as a transitional space. Thus, any small change of direction seems to act as a deterrent, but not the number or preferred location for static people as previously discussed. Bank Corner and Finsbury Av. illustrate this problem very clearly. People do arrive at the public spaces through the local and global properties of the configuration of the urban grid. Once there, unless a convenient situation is created for the pedestrian to cross the public space, that is, free access or a strategic location that makes any detour relatively laborious, pedestrians will divert from the public space and utilise the surrounding pavement. This is why the potential diagonal route in Bank Corner under-performs for the number of moving people in relation to the integration value of the respective axial line, whereas Threadneedle Street route over-performs. That is, the level of pedestrian movement is lower or higher than expected according to the integration values of the axial lines for this particular system. Part of pedestrian movement is being diverted.

However, the detour of pedestrian through-movement does not have to be seen as a negative attribute of the public space. Indeed, studies of preferred locations for static occupancy often suggest that people select locations within view of a busy stream of moving people. Therefore, the conclusion of this section might be relevant when looking at the static occupancy of spaces by people, which will be studied in the next section.

6.2. PATTERNS OF STATIC OCCUPANCY

It has been suggested in Chapter 5 that the level of static people in public spaces is a function of the configuration of the urban fabric, a property that can be numerically expressed by the public space strategic value. An additional important issue in the performance of public spaces is an effective use of the available space, with all areas receiving reasonable good levels of static occupancy. It is conjectured that a better understanding of how people organise themselves inside public spaces is important to assist on the design and therefore optimise their use.

The implications are clear. Neglected areas are under-used and are therefore not fulfilling their purpose. In this respect, there are two aspects to be addressed. Firstly, whether there is a consistent pattern for the preferred location of static people inside public spaces and whether this is a function of the configuration of the urban fabric. Secondly, whether there is a consistent pattern regarding the gradual occupation of public spaces and if it is also related to the configuration of the urban fabric.

Knowledge of preferred areas for static occupancy can only help in the design of public spaces. An important outcome is the adequate provision of seating. Gehl (1987) emphasises. "Only when opportunities for sitting exist can there be stays of any duration. If these opportunities are few or bad, people just walk on by. This means not only that stays in public are brief, but also that many attractive and worthwhile outdoor activities are precluded" (Gehl, op.cit., p157). However, the adequate provision of seating areas is not the only aspect to be addressed. Knowledge of patterns of static occupancy is also helpful for best locating decorative elements or retail outlets, for instance, as the areas that are likely to be less popular can be used to accommodate such facilities.

In the literature review (Chapter 2), important points were highlighted regarding patterns of static use. Firstly, from studies based mainly in the USA, it was suggested that the gradual static occupation of public spaces follows an outside-to-inside movement[11], named the edge effect[12]. Hillier[13], in a series of studies of the performance of public spaces, suggests that good locations for unprogrammed static use (that is, uses that do not depend on the provision of specific attractors or facilities) were found to be those which were convexly close to the intersections of axial lines. From his research, Hillier concluded that attractors such as wine bars are not necessarily a key element, but that the static occupancy of public spaces may be associated to "the visual properties of space experienced by the stationary person" (Hillier et al., 1990a, p26). According to Hillier and colleagues, popular stopping points are the ones with extensive isovists, where a quantifiable representation of the degree to which a location is visually strategic can be carried out through the convex isovist. A second important point regarding static occupancy, refers to the idea that specific static

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[11] See Joardar and Neill, 1978; Whyte, 1980; Korosec-Serfaty, 1982; Marcus and Francis, 1990 and Carr, 1995.

[12] De Jonge, 1967 and Gehl, 1987. See Section 2.6 in Chapter 2.

[13] Hillier, 1984; Hillier et al., 1990a and Hillier et al., 1990b.

activities are restricted to particular locations[14].

The research sets out to investigate how the pattern of static occupancy is a function of the spatial form of public spaces in relation to the configuration of the urban fabric in which they are embedded. To the extent that this is the case, it will then be possible to develop quantitative models for the prediction of static people's gradual occupation and preferred location inside public spaces. The analysis starts by looking at whether there are consistent patterns regarding the distribution of static people inside public spaces throughout the day. Subsequently, the issue of whether the occupation of public spaces follows an outside-to-inside movement as suggested, and whether it is affected by the configuration of the urban fabric is examined. Lastly, the research examines to what extent different activities are clustered around particular locations.

6.2.1. FIELD WORK

Data on static occupancy was collected using the "snapshots" technique[15]. The observations were very comprehensive, including information on the type of users, their location, activities and position (sitting or standing), and were recorded on public space plans. All twelve public spaces were observed on two different days but at precisely the same time of day to provide a good comparison of data.

The data was collected over two separate days for each public space[16] for the following ten times: 8:40 am, 10:40 am, 12:10 pm, 12:40 pm, 1:10 pm, 3:40 pm, 4:40 pm, 5:40 pm, 6:40 pm, and 7:40 pm. The times selected for the data collection were derived from the static occupancy graphs, described in Chapter 5. Preferred static location is studied based on the off-peak period for static occupancy, because it is during these times when, in theory, people are able to exercise the greatest choice in selecting their preferred seating areas. The time periods are as follows: 8:40 am, 10:40 am, 3:40 pm, 4:40 pm, and 5:40 pm. 1817 people were counted. As for the gradual occupation, static occupancy is studied based on the first five times: 8:40 am, 10:40

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[14] See Burden, 1977; Marcus and Francis, 1990; Carr, 1995 and Lennard and Lennard, 1995.

[15] The snapshots technique involves graphically recording on paper, in this case, the public space plans, what is being seen in situ, like a "mental photograph" (Observational Procedures, 1997-98) of static behaviour. See also Francis, 1984.

[16] The data on static occupancy was collected between July 17th and August 22nd, 1996 as described in Section 5.2.1, Chapter 5.

am, 12:10 pm, 12:40 pm, and 1:10 pm, when a total of 5012 people were counted. All the data is illustrated in Plates 6.9 to 6.20 in Appendix 4.

6.2.2. PATTERN OF STATIC OCCUPANCY IN THE SELECTED CASES

A preliminary inspection of the results of the twelve public spaces showed different patterns of static occupancy, with only four cases (Table 6.3) following a clear outside to inside pattern of occupation. Table 6.3 gives a summary description of the selected spaces according to their patterns of occupancy and morphological characteristics. The variable entitled "quality of street furniture" relates to the number of designated seating areas, not counting secondary sitting places such as street curbs or flowerbed walls.

Public space name	Origin	Presence of catering facilities	Quality of street furniture	Level of enclosure	Pattern of occupation of static people
Abchurchyard	former churchyard	yes	poor	high	no clear pattern
Bank Corner	building development	no	medium	low	inside(centre) to outside
Exchange Square	office complex	yes	good	high	outside to inside
Fenchurch	building development	yes	medium	medium	outside to inside
Finsbury Av.	office complex	yes	good	high	inside to outside
Fleet Place	office complex	yes	medium	high	outside to inside (back)
Love Lane Corner	former church site	no	good	medium	outside to inside
New Change	building development	yes	medium	low	no clear pattern
North Guildhall	building development	no	poor	medium	back to front (both inside)
Royal Exchange	building development	yes	medium	medium	outside, centre, outside
St.Anne/St.Agnes	former churchyard	no	good	medium	no clear pattern
Whittington Gds	former churchyard	yes	good	medium	inside (centre) to outside

Table 6.3. Description of the twelve selected public spaces

Before starting a detailed quantitative analysis of the results, it is instructive to look at the general characteristics of each public space regarding the observed static behaviour, to determine the best way to analyse the results. This preliminary analysis was carried out based on a visual inspection of the data presented in Plates 6.9 to 6.20 (Appendix 4).

6.2.2.1. Abchurchyard

A visual inspection of the data on the preferred location for static occupancy did not reveal any constant pattern (Plate 6.9, Appendix 4). There are four benches aligned alongside the church entrance. However, the observation showed that on some occasions people would start occupying the seats near to Abchurch Lane and progress towards Sheborne Lane. On other occasions the opposite pattern was noted. People sitting on the central seats and then occupying the ones towards the edges.

6.2.2.2. Bank Corner

The analysis (Plate 6.10, Appendix 4) suggests a preference for the inner core of the public space, moving towards the seats by the steps of the Royal Exchange building, back around a statue at the front of the public space and finally gradually occupying the steps of the Royal Exchange building. The recorded data also shows that, after 5:00 p.m., the preferred location for sitting is distributed equally between the seats at the centre of the public space and the seats facing the steps of the Royal Exchange building. As far as the preference for the seats facing the steps of the Royal Exchange building is concerned, it could indicate some correlation with the entrance to the London underground system. From the observations carried out during the summer of 1996, it became clear that very often people use public spaces as "waiting areas", generally reading, waiting or perhaps passing time before catching a train.

6.2.2.3. Exchange Square

The gradual static occupation (in contrast to Bank Corner) follows an outside-to-inside movement. The first places to be occupied are the wooden benches by the Exchange House building (Plate 6.11, Appendix 4), moving east by the wine bar/coffee shop and around a sculpture, a favourite spot for local construction workers. Occupation gradually moves to the west and south by the two remaining wine bars. The central core is the last place to be occupied. After 5:00 pm, the occupation of Exchange Square is limited basically to the areas surrounding the wine bars, typical behaviour for all public spaces that have a wine bar or public house in the vicinity. Abchurchyard is the only exception to this behaviour because its wine bar does not affect the type of users of the public space, as discussed in Chapter 5.

6.2.2.4. Fenchurch Place

Initial observation suggests that the gradual occupation follows an outside-to-inside movement with a clear west to east pattern (Plate 6.12, Appendix 4). Once all the purpose-built seats are occupied, people move towards the walls surrounding the existing trees and the few flowerbeds in the public space. It is important to point out that all the trees and flowerbed walls are at a good comfortable height, close to the height of the rest of the seats. Once the public space is full, there is a bias in concentration to the west side, mainly due to its proximity to a public house. Like Exchange Square and all the other spaces with wine bars or pubs, after 5:00 pm, the preferred location for sitting or standing is very much dictated by the proximity of the catering facilities.

6.2.2.5. Finsbury Av.

The gradual occupation of Finsbury Av. (Plate 6.13, Appendix 4) seems to follow two distinctive patterns. Occupation starts in the inner area, where the first seats to be occupied are the inside purpose-built ones looking towards the pond area, and moves gradually to the outside ones. Also, the wall around the pond works very well as a seating area which is occupied from the outside, moving gradually to the inside, in this case, looking to the central area of the public space where the purpose-built seats are. The recorded data seems to suggest that people actually sit down in order to be able to look at the pedestrian movement that crosses the public space from Appold Road towards Eldon Street, although in real terms it is not intense. Once both areas are occupied, the tendency is for a high concentration of static people near the wine bar, and eventually people start sitting on the steps around the central area. The tendency for people to stay near the wine bar after 5:00 pm, already observed in the other spaces, is also found in Finsbury Av.

6.2.2.6. Fleet Place

The analysis of the gradual occupation in Fleet Place seems to indicate that it starts at the south side of the public space, increasing gradually towards the north side, with the area used by the wine bar being the last one to be occupied (Plate 6.14, Appendix 4). On the other hand, the number of office smokers, as discussed previously, is very high. From all people using the public space from 9:20 am until 11:50 am, 19.15% of all static people in the public space were office smokers and they usually chose the seats close to the entrance of 1 Fleet Place building, at the south side of the public space. After 5:00 pm, the occupation of Fleet Place is limited to the area surrounding the wine bar.

6.2.2.7. Love Lane Corner

An analysis (Plate 6.15, Appendix 4) clearly shows a preference for the hard surface area, by the wall of the police station building, starting at the seats further away from the street. From there, people move towards the seats that are placed along the other building façade by Aldermanbury. The next area to be occupied is the one with high vegetation. Finally, people move towards the grass surface area that occupies most of the central area of the public space and lastly the steps of the footbridge. But, during the morning period people start sitting towards the rear side of the public space on the hard surface area, and there are indications that this pattern changes during the afternoon when people tend to sit close to the pavement. Like Bank Corner, this may be related to the "waiting area" function that public spaces may hold. By sitting close to the edges, they have a better view of the approaching pedestrians which makes the meeting process easier.

6.2.2.8. New Change/Cheapside Corner

Due to its relatively small size and the fact that New Change/Cheapside Corner becomes occupied almost instantaneously, it is not clear, from the recorded data, if the occupation of the space follows a specific pattern (Plate 6.16, Appendix 4). Although after 5:00 pm, the users tend to concentrate near the wine bar, in off-peak hours, static people seem to occupy the seats in a random way, with no clear preference for seats near the entrances or away from them.

6.2.2.9. North Guildhall

The gradual occupation of the public space seems to follow a peripheral pattern, with people sitting on the concrete seats in the main area or around the fountain on the west side (Plate 6.17, Appendix 4). Once these seats are occupied, they tend to move to the tiers of steps overlooking the main area near the access to the Barbican Centre and finally to the steps near the fountain. However, during the afternoon period, of all the available places to sit, the data collected seems to suggest that the short wall around the fountain is the most popular place. It is suggested that this is related to the "waiting area" phenomenon and that the fountain may be used as a good surveillance point.

6.2.2.10. Royal Exchange

It was observed (Plate 6.18, Appendix 4) that people prefer to sit on the south side, moving gradually to the north, with people sitting on the wooden seats near Cornhill and gradually moving towards the seats near Threadneedle Street. When these seats are partially occupied, users tend to move towards the seats around the statue near Royal Exchange Av. and by the wine bar. Once all the seats are taken, users move towards the façade of the "Bayerische Vereinsbank" building and sit on the ground and around two statues at the public space entrances. After 5:00 pm, static occupancy is restricted to the wine bar.

6.2.2.11. St. Anne & St. Agnes churchyard

As far as the occupation of the space is concerned, initial observation suggests that, like Fenchurch Place, any place is a convenient place (Plate 6.19, Appendix 4). All the available wooden seats on the hard surface area and in the area along Noble Street are occupied simultaneously, but without either of the two areas being more used than the other. Once the seats are occupied, people start sitting around the flowerbeds and finally start occupying the grass areas by the church walls.

6.2.2.12. Whittington Gardens

The gradual occupation of Whittington Gardens (Plate 6.20, Appendix 4) follows a similar pattern to the one observed for Bank Corner. It starts at the centre of the public space, by the two wooden benches that overlook the fountain. Gradually, people start occupying the back seats, at which point the single bench by the flowerbed that faces Cannon Street is taken. Once the wooden seats are full, people tend to gather by the brick wall, outside the public space. As usual, the preferred location at 5:00 pm is limited to areas closer to the wine bar, that is; by the brick wall where people basically stand outside. Once the brick wall area is full, people start moving to the inside of the public space and occupy the seats, which are nearer the entrance. The garden area on the east side tends to be occupied only during the lunchtime period and it works almost as an independent area from the rest of the public space. It is mainly used by people sunbathing during the summer. Its pattern of occupation also differs from the main hard surface area of Whittington Gardens. It starts by being occupied from the north side, by College Street and gradually people start occupying the areas closer to Upper Thames Street.

6.2.3. OVERLAPPING POINT ISOVISTS

To further investigate the relationship of the strategic location of public spaces to adjacent areas, two public spaces, Abchurchyard and Bank Corner, are examined in more detail, illustrated in Figure 6.11. Bank Corner is a very exposed space to the surrounding areas and it is strategically located at a major road intersection. The convex isovist drawn from within the public space is very extensive and the number of branches is also very large, at least eleven, making it visible from a high number of different locations simultaneously. Conversely, Abchurchyard is quite an enclosed space, it has a smaller convex isovist compared to Bank Corner[17] and very significantly it branches out into three main directions, as highlighted by the arrows in Figure 6.11. The implications are that on arrival at a street junction (point A as an example), the pedestrian could turn right, or left or even take the diagonal route south and incorporate Bank Corner in his route. The difference between Bank Corner and Abchurchyard is that Bank Corner is seen from a much higher number of intersections of directions.

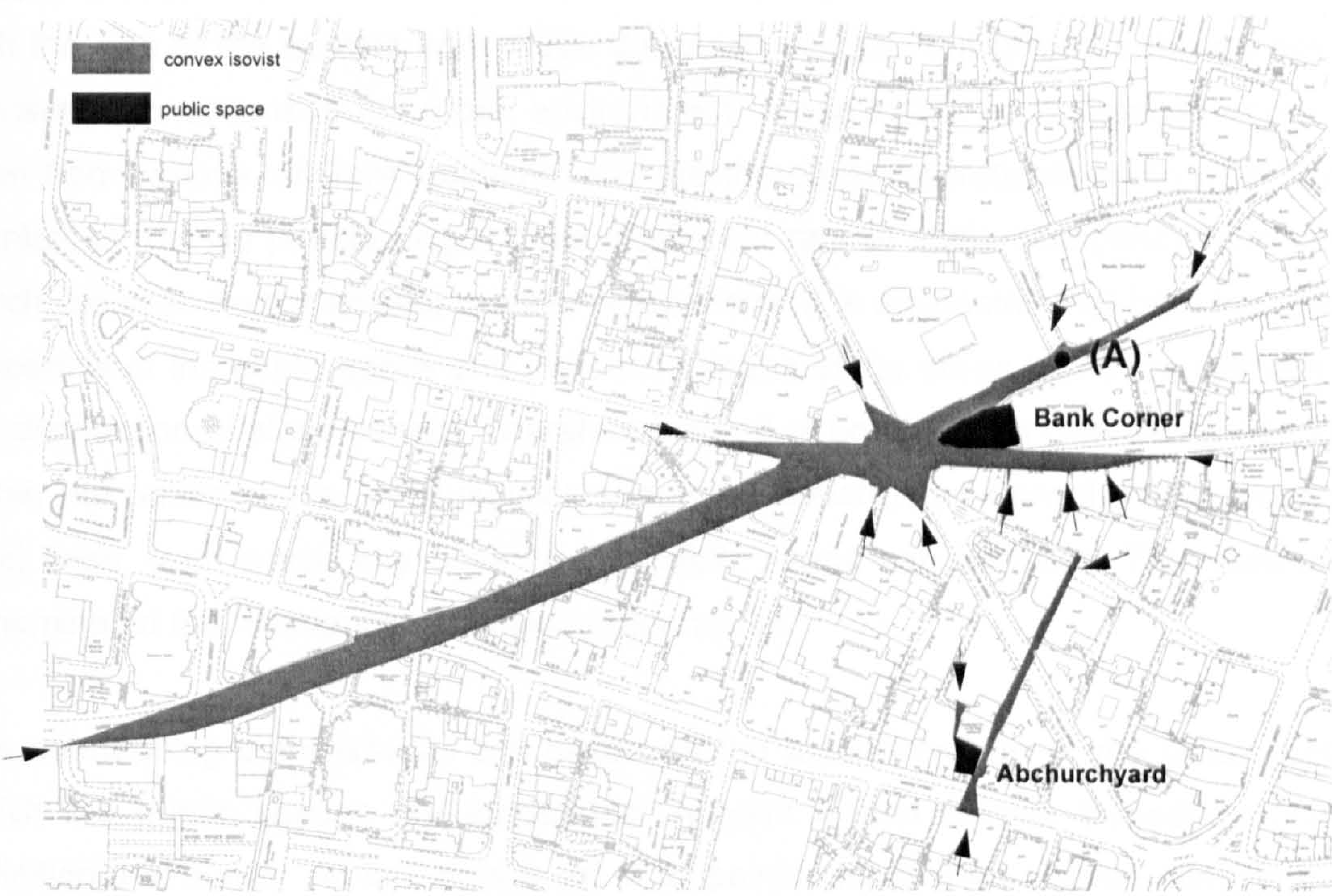


Figure 6.11. Comparative convex isovists for Abchurchyard and Bank Corner (scale 1:6000)

When looking at the size of the isovists from within public spaces, as the quantifiable measurement for patterns of static occupancy, a conceptual problem arises. How to define the convex space where the isovists should be drawn up without biasing decisions? Designated seating areas cannot be a criterion, as this excludes curbs,

[17] Approximately 20 times smaller. Refer to Table 4.4, Appendix 2.

steps, small walls, and any kind of secondary seating. The problem becomes even more complex when looking at standing static occupancy. Ideally, isovists should be drawn from every possible seating or standing area, that is, every single point in space. In addition, for large public spaces, like Exchange Square, it is easy to imagine that unless the user is very familiar with the public space, it is unlikely that the person will have the time or energy to survey the entire public space to establish which spot will provide the best views or the largest isovist. It is more likely that users will place themselves near or in the view from where they are entering the public space.

A new methodology is proposed, where the observer is now considered to be outside rather than inside the public space. Therefore instead of investigating how far we can see from within public spaces, the investigation asks: From how many different directions can the public space be seen from the surrounding area? Informal analysis suggests that the preferred locations for static people is not necessarily associated with the size of the isovists from within the public spaces, but rather to the multiplicity of visual connections to the urban environment. Areas inside public spaces which are seen from various different locations, and are therefore theoretically seen by a higher number of moving people, might have a different rate of static occupancy than areas which are seen from a smaller number of locations. It is suggested that both the spatial properties of the public space and the configuration of the urban fabric are relevant for the distribution of static people. Therefore instead of constructing convex isovists from within the public space, point isovists should be constructed from the intersection of axial lines, from which any point of the public space can be seen. This method is denominated the "overlapping point isovists analysis".

The overlapping point isovists are based on the axial break up of the urban grid in which the public spaces are embedded. A point isovist follows Benedikt's (1979) definition that states "An isovist is a set of all points visible from a given vantage point in space and with respect to an environment" (Benedikt, op.cit., p47). In this case, the intersection point of two or more axial lines defines the vantage point from which any segment of the public space can be seen, covering all the possibilities. The axial line intersection points are all the positions from which a potential observer will face a choice of either moving through the body of the public space or selecting an alternative route. Fenchurch Place is used as an example to illustrate how overlapping point isovists can be calculated. After the axial break-up map was designed, eight intersection points have been identified, as shown in Figure 6.12.

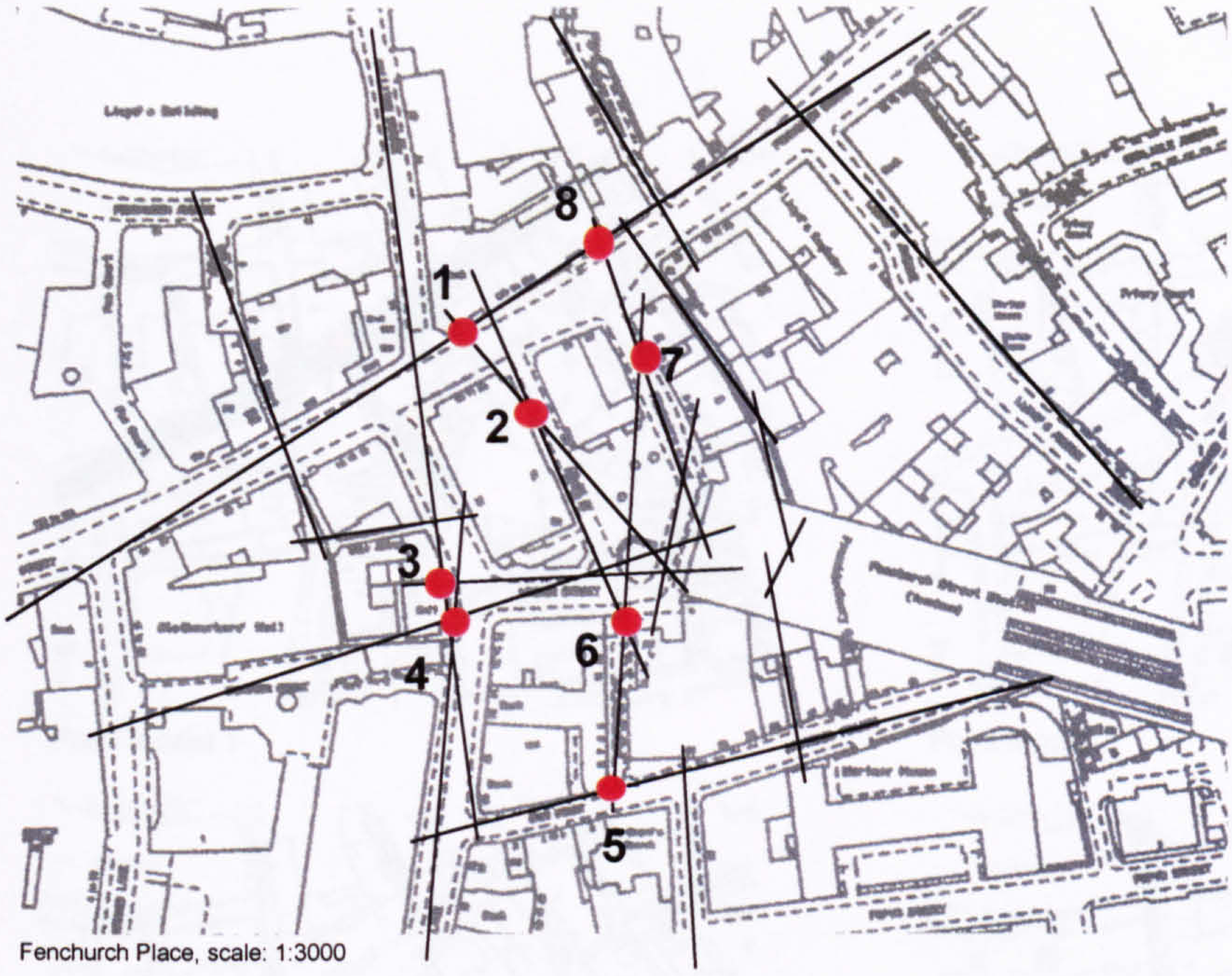


Figure 6.12. Fenchurch Place illustrating the axial lines intersection points

From each of the intersection points, point isovists were constructed as seen in Figures 1 to 8 in Plate 6.21 (next page). Then, by overlaying all the point isovists on the public space (Fig. 6.13), a series of convex spaces are created, illustrated in Figure 6.14.

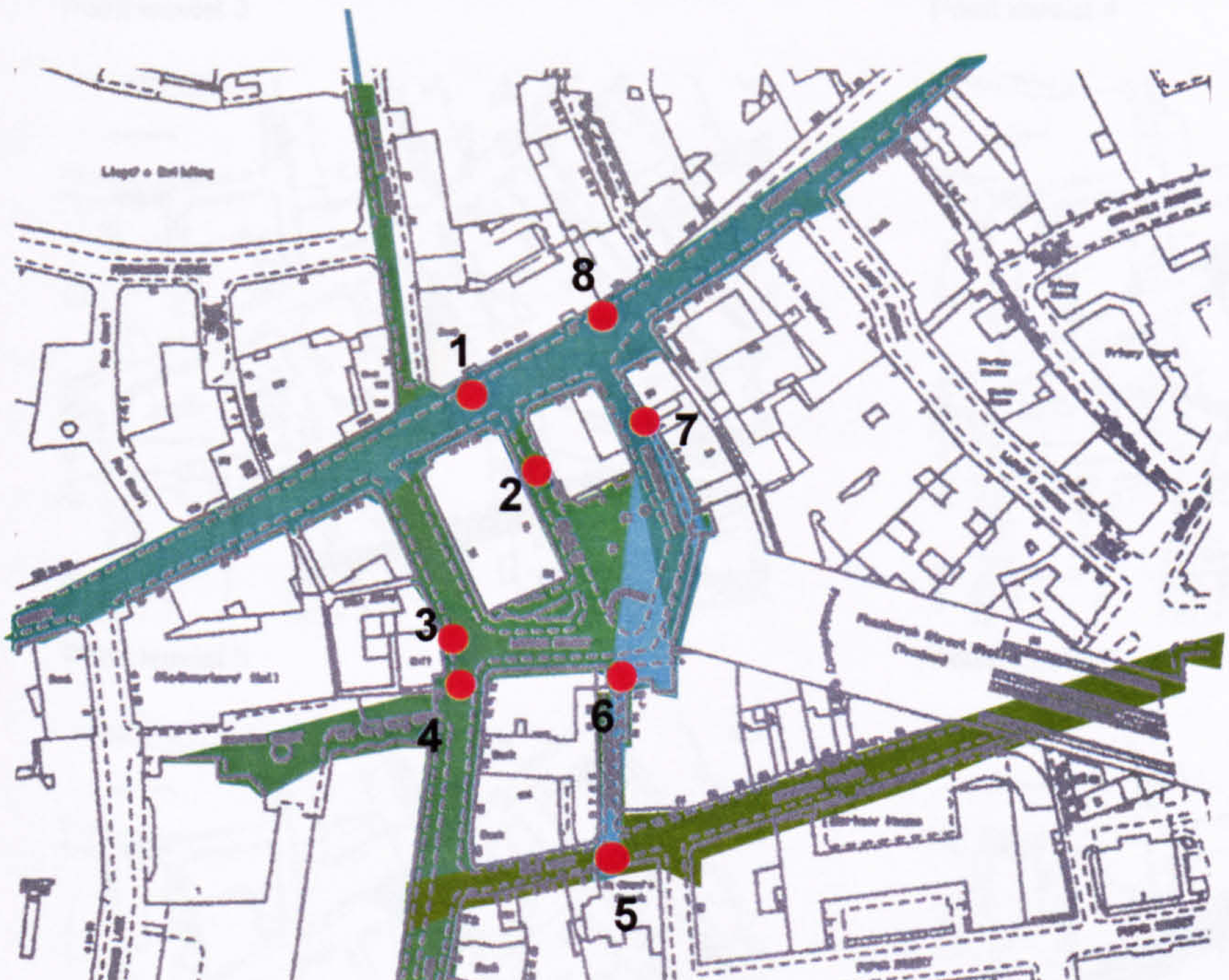
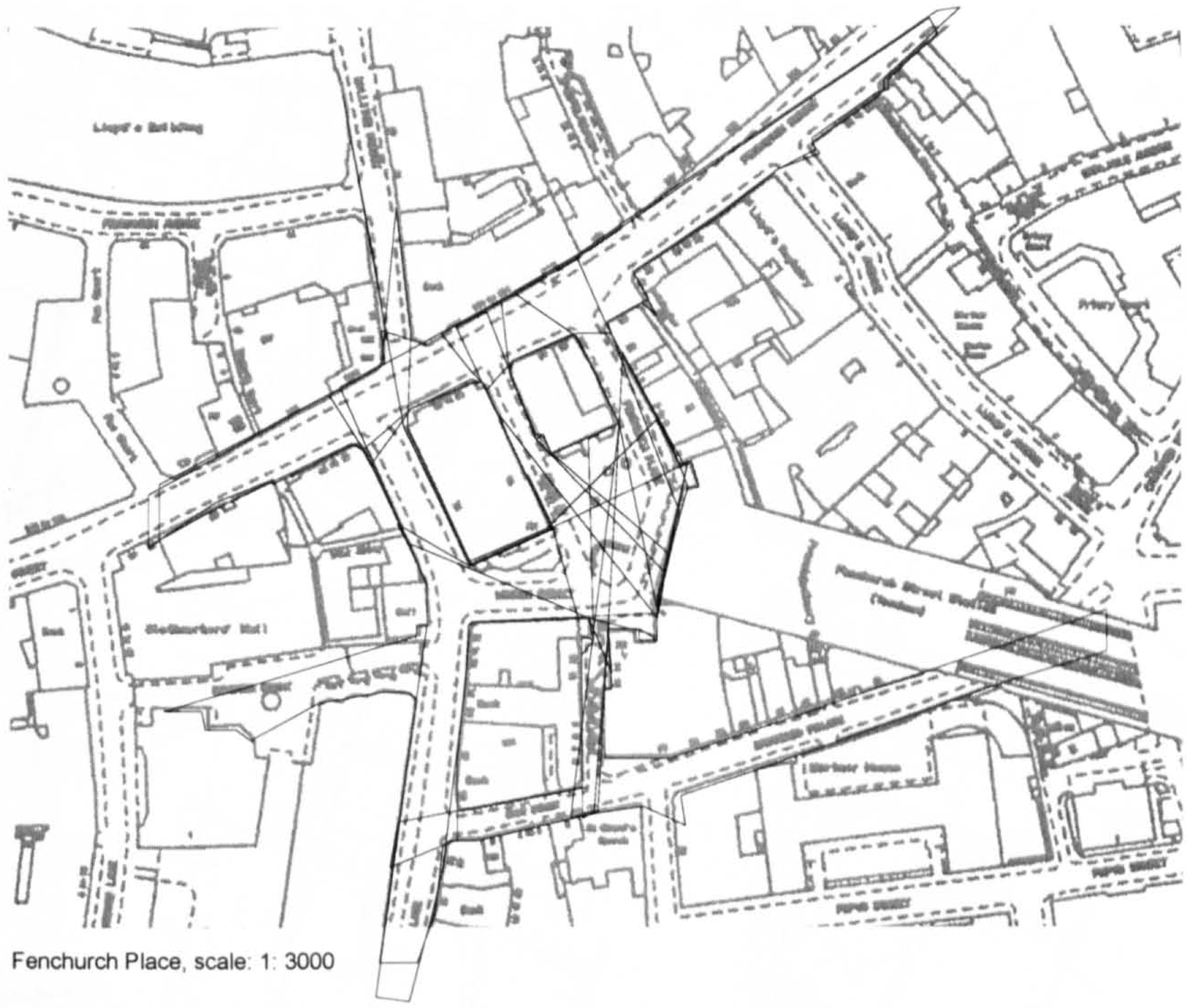


Figure 6.13. Fenchurch Place illustrating the overlapping point isovists

Plate 6.21. Fenchurch Place and respective point isovists



Fenchurch Place, scale: 1: 3000

Figure 6.14. Fenchurch Place illustrating the resulting overlapping convex spaces

To quantify how many times a convex space is seen from different intersections, it was calculated how many times an isovist or a segment of an isovist would cover the specific area for each convex space. This procedure revealed significant variations amongst the twelve cases. For instance, in the case of Abchurchyard, the overlapping varied from 1 (the convex space with the minimum number of overlapping segments) to the maximum of 4 (the convex space with the maximum number of overlapping segments). Conversely, for Bank Corner the variation spanned from a minimum of 5 to a maximum of 16 overlapping counts, denominated the "coverage density". Higher coverage density signifies a higher degree of visual exposure. The coverage density for each public space was equally divided into a scale with six bands. This scale was colour graded, from red to blue, where red represents the maximum coverage density, and blue the minimum. Each convex space was then ranked according to this six-band scale. Consequently, the convex spaces are the areas that do not necessary have the longest or the largest isovists, but are the most visually exposed spaces. They can be seen from the highest number of different locations simultaneously. It is a result purely of the relationship between the spatial layout of the public space and the configuration of the surrounding fabric. This procedure was used for all the remaining cases. Plate 6.22 (next page) shows the intersection points for all twelve public spaces and Plate 6.23 (page after next) shows the overlapping point isovists maps.

Plate 6.22. Axial lines intersection points

scale: 1:7000

axial lines intersection points | public spaces | axial lines

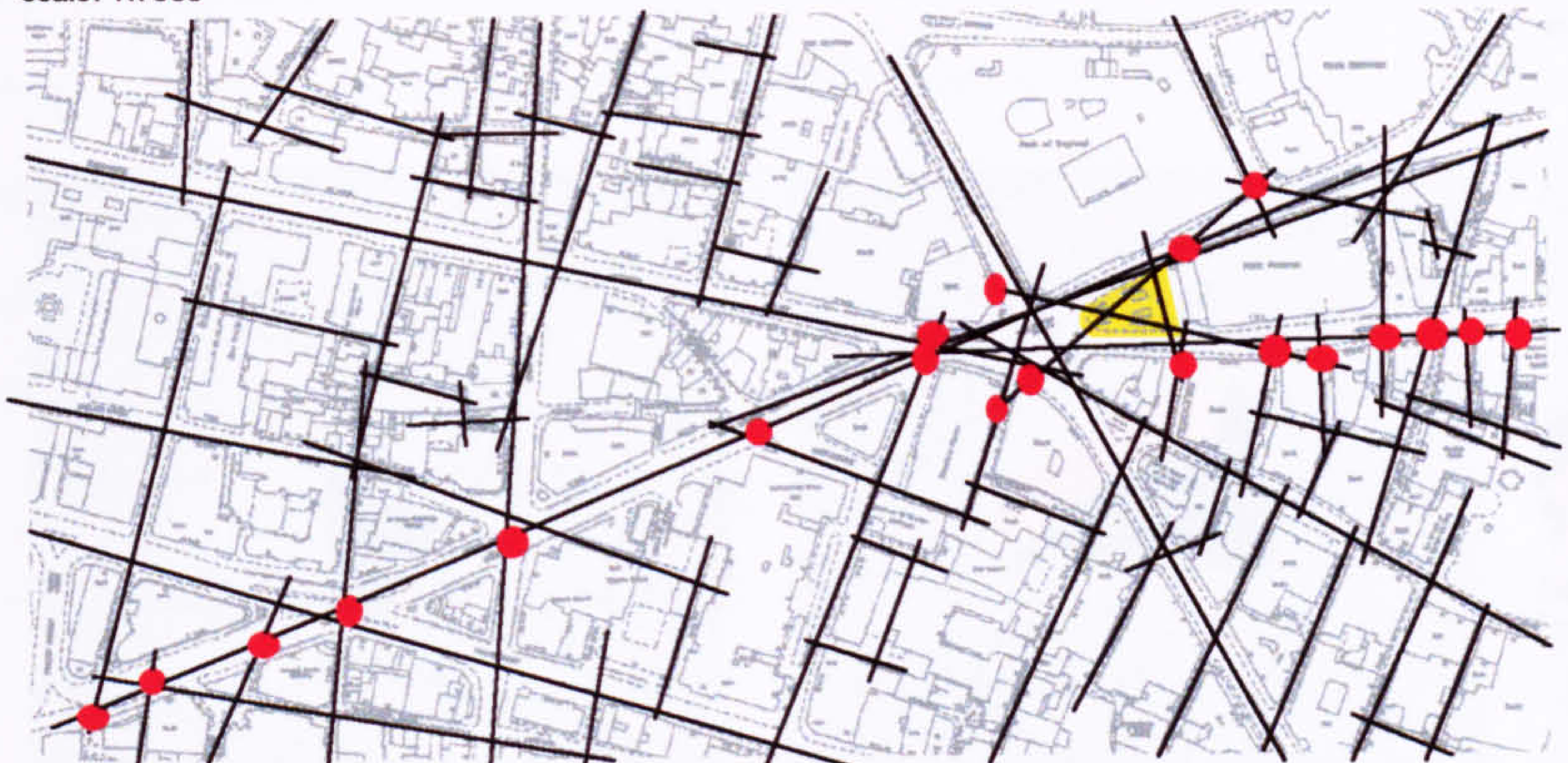


Fig. 1. Bank Corner

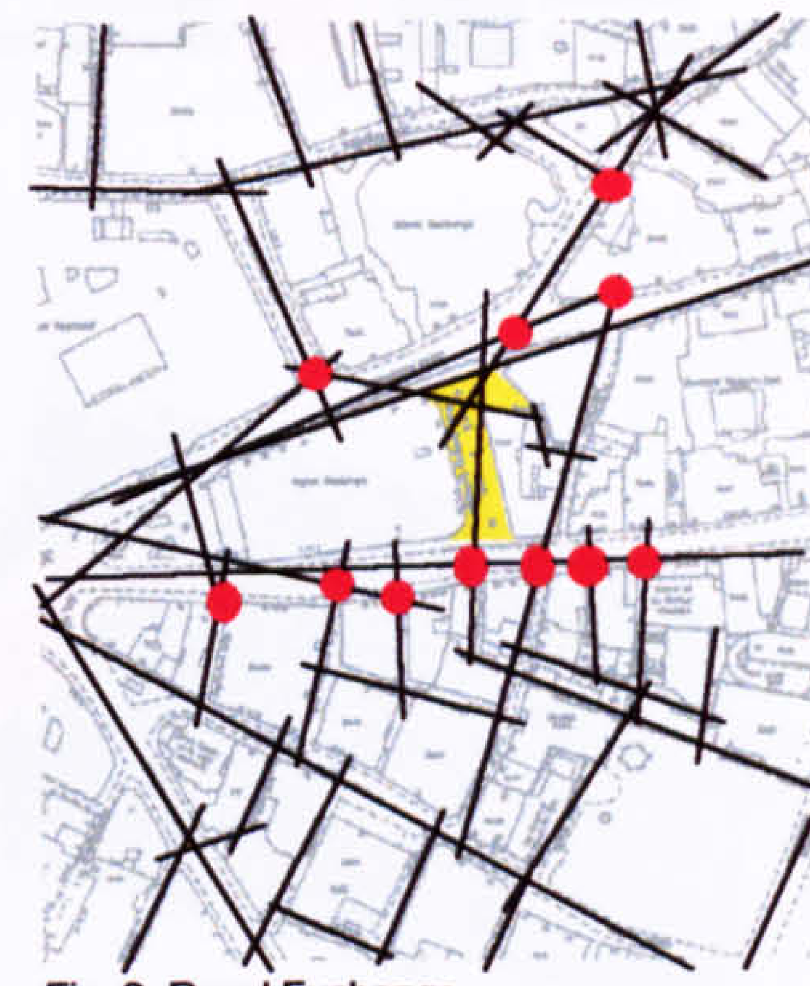


Fig. 2. Royal Exchange

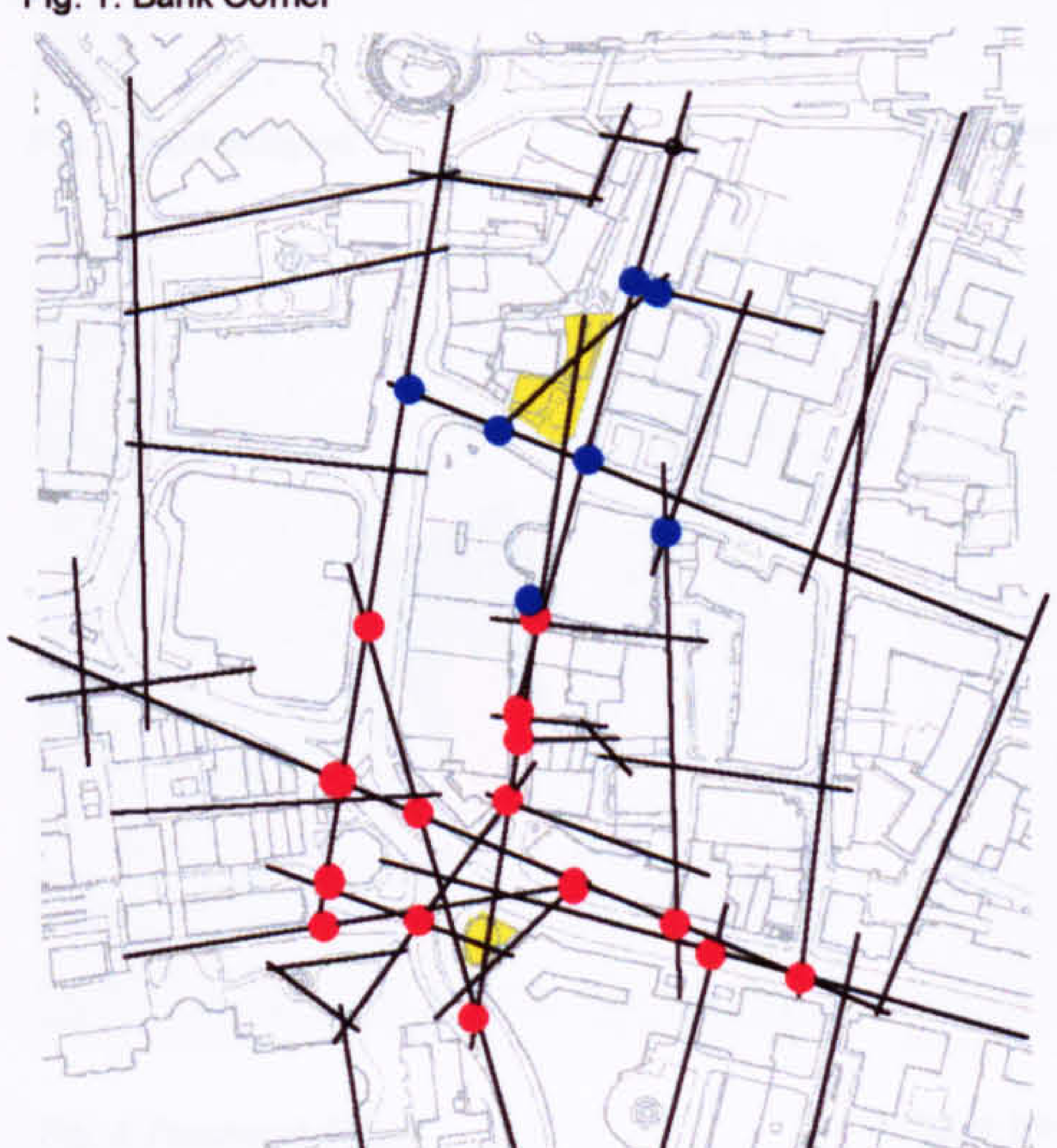


Fig. 3. New Change and Fig. 4. St. Anne churchyard

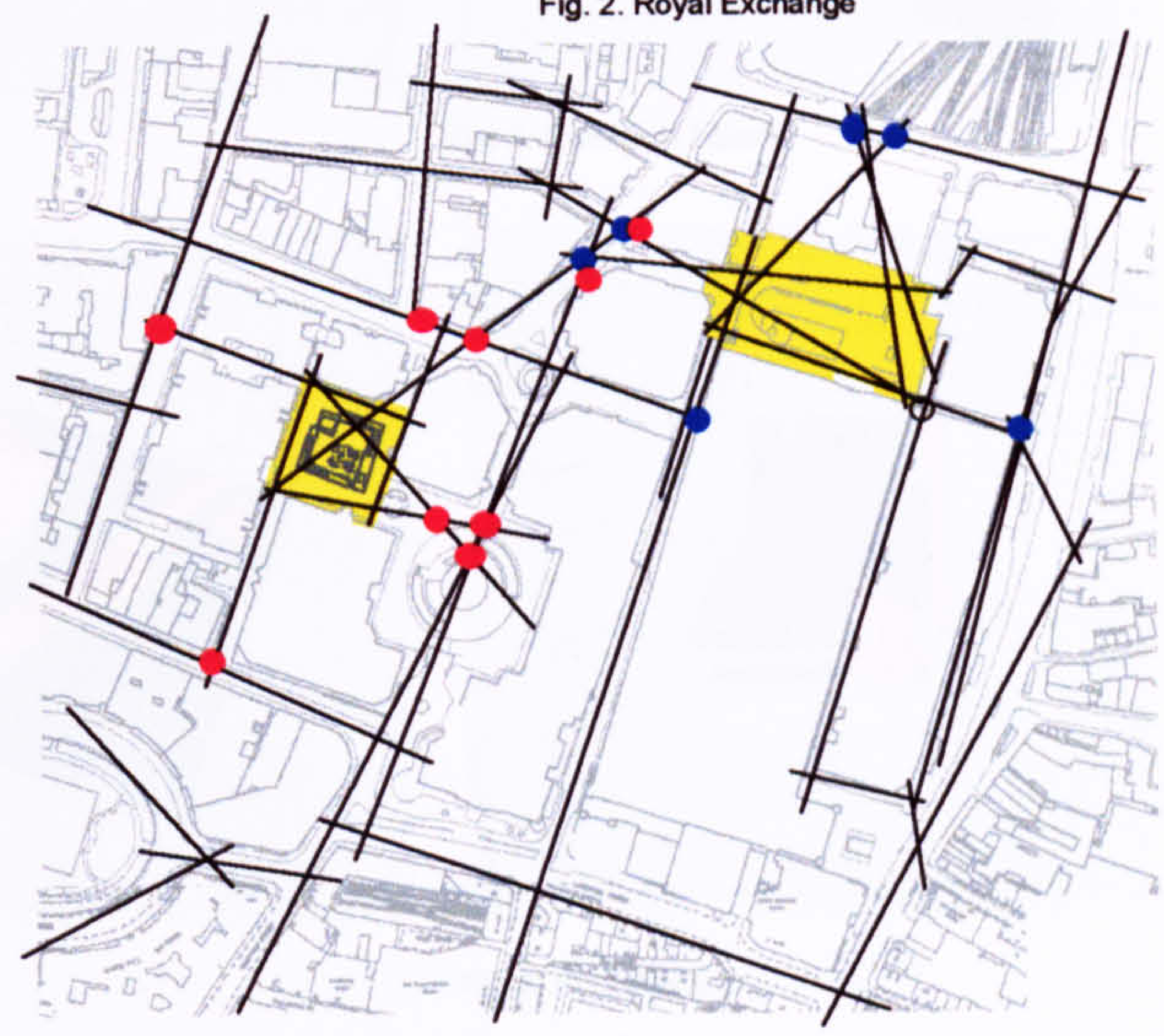


Fig. 5. Finsbury Av. and Fig. 6. Exchange Square

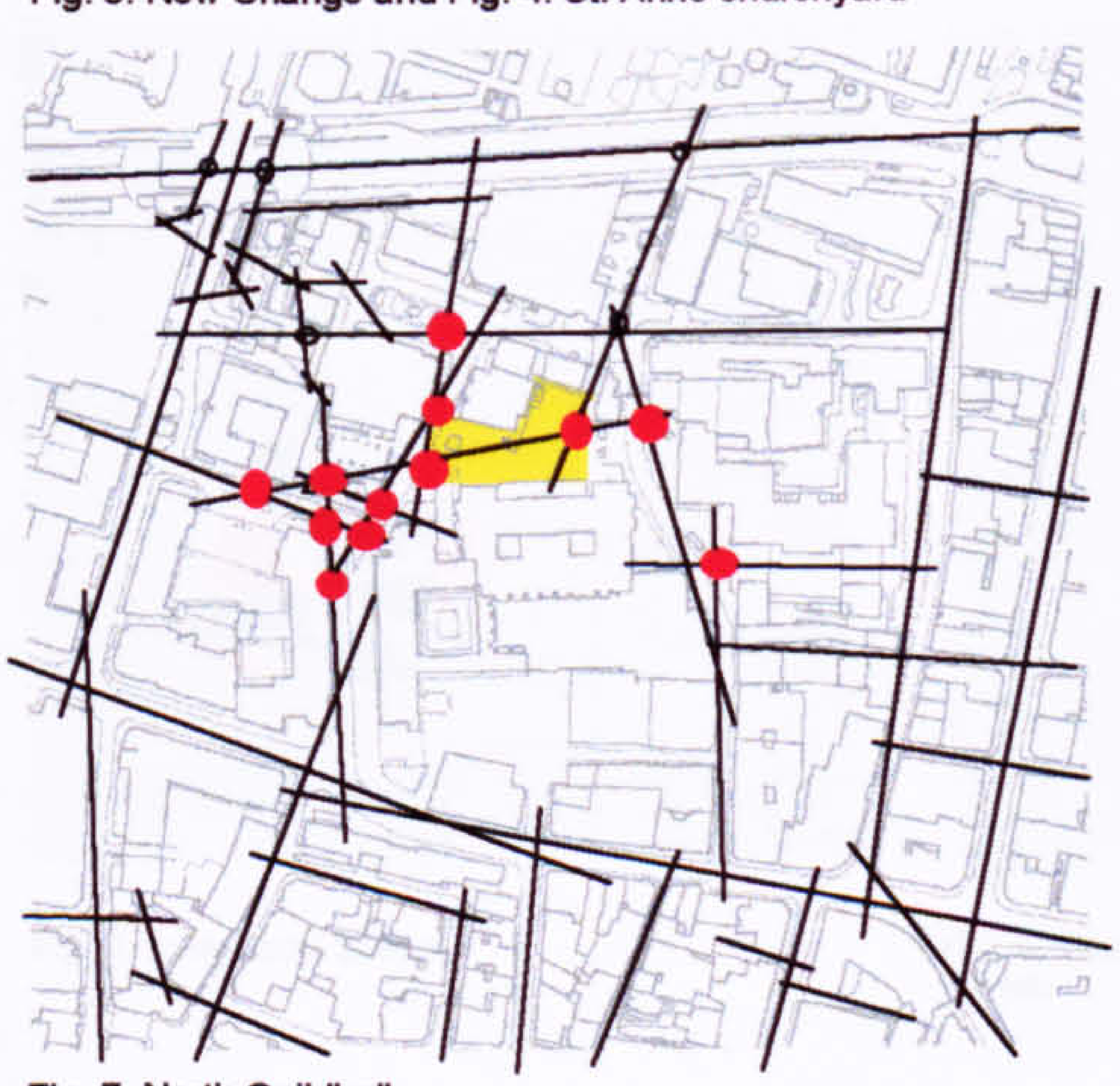


Fig. 7. North Guildhall

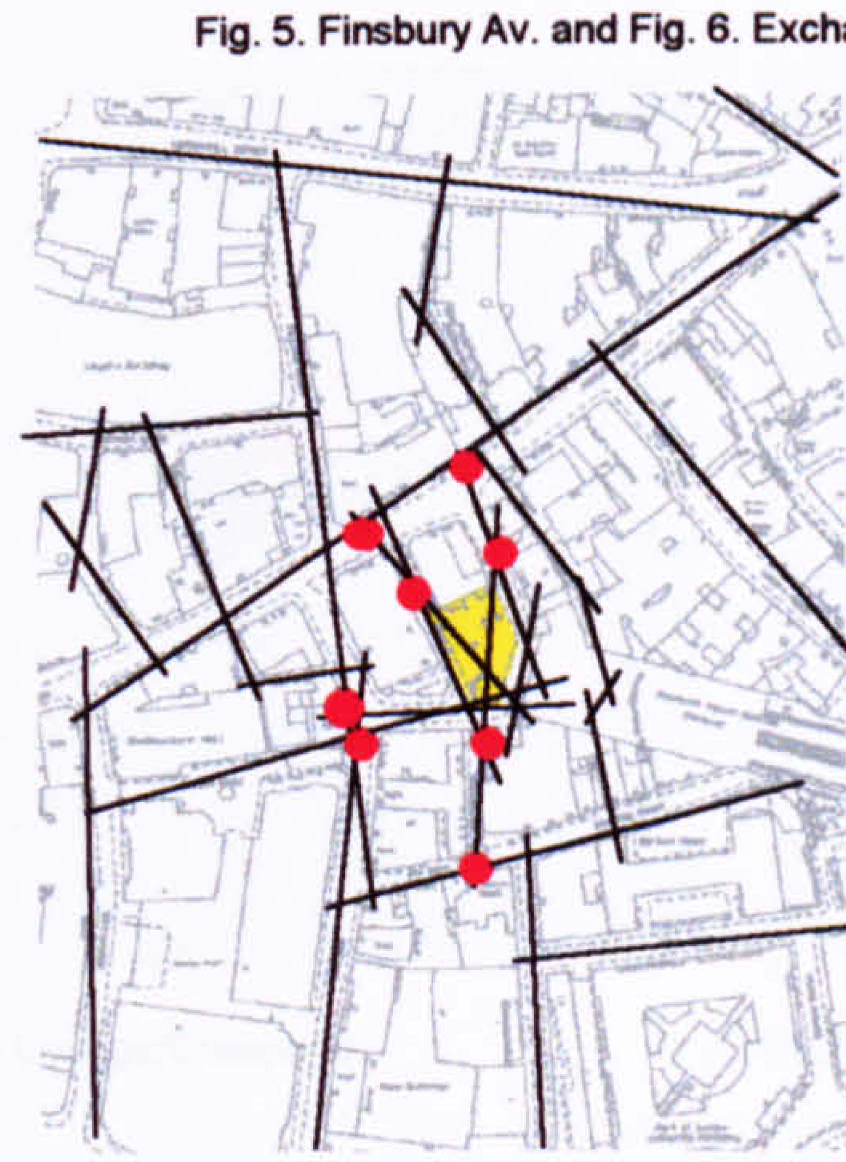


Fig. 8. Fenchurch Place

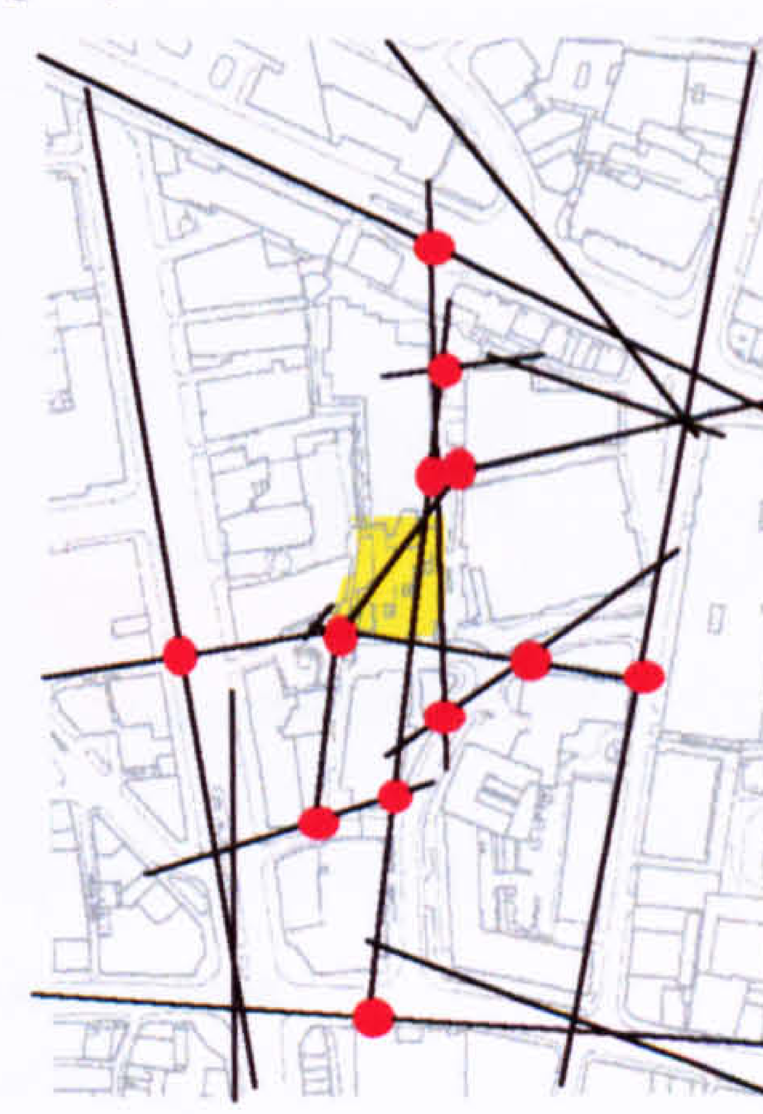


Fig. 9. Fleet Place

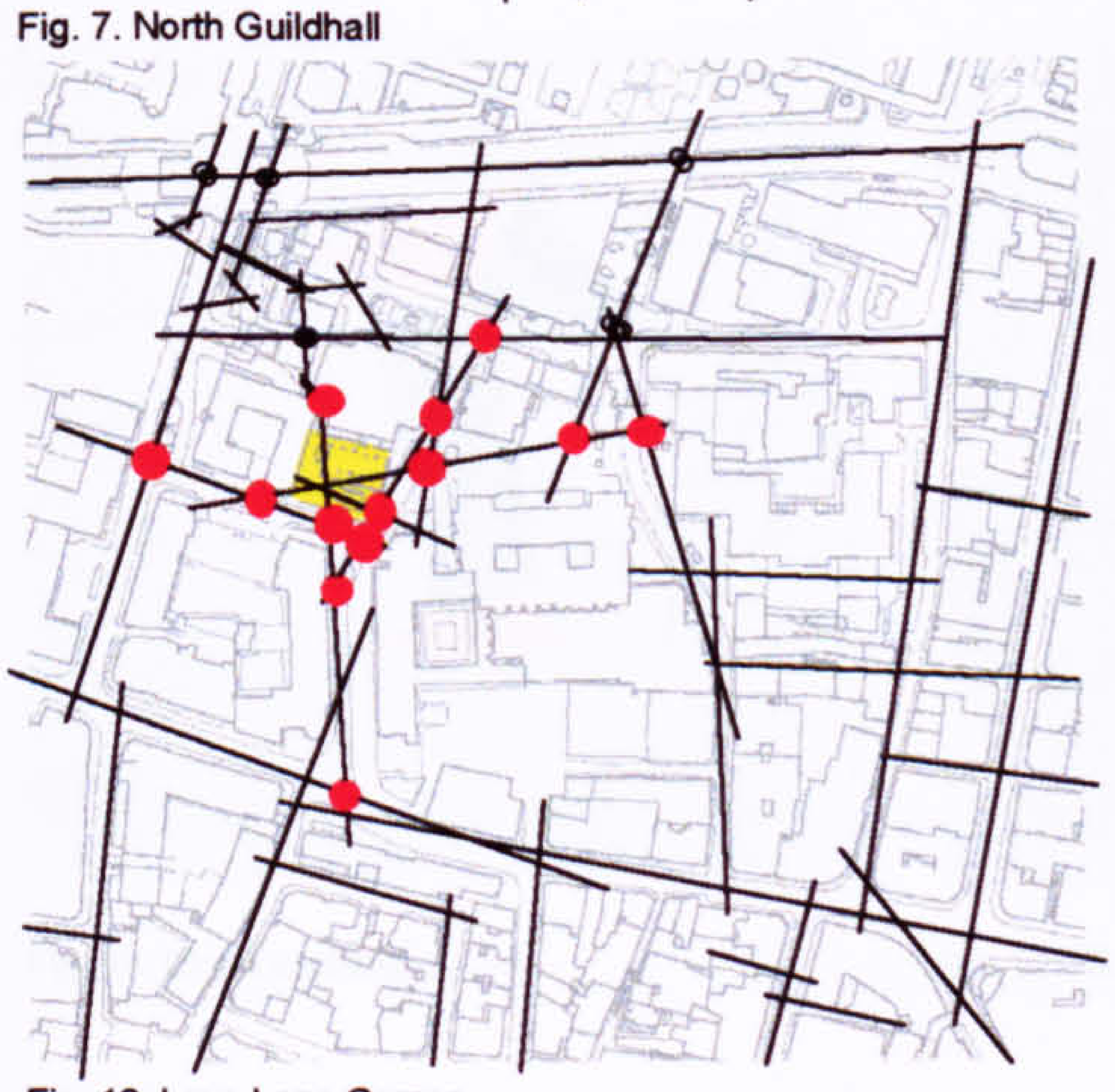


Fig. 10. Love Lane Corner

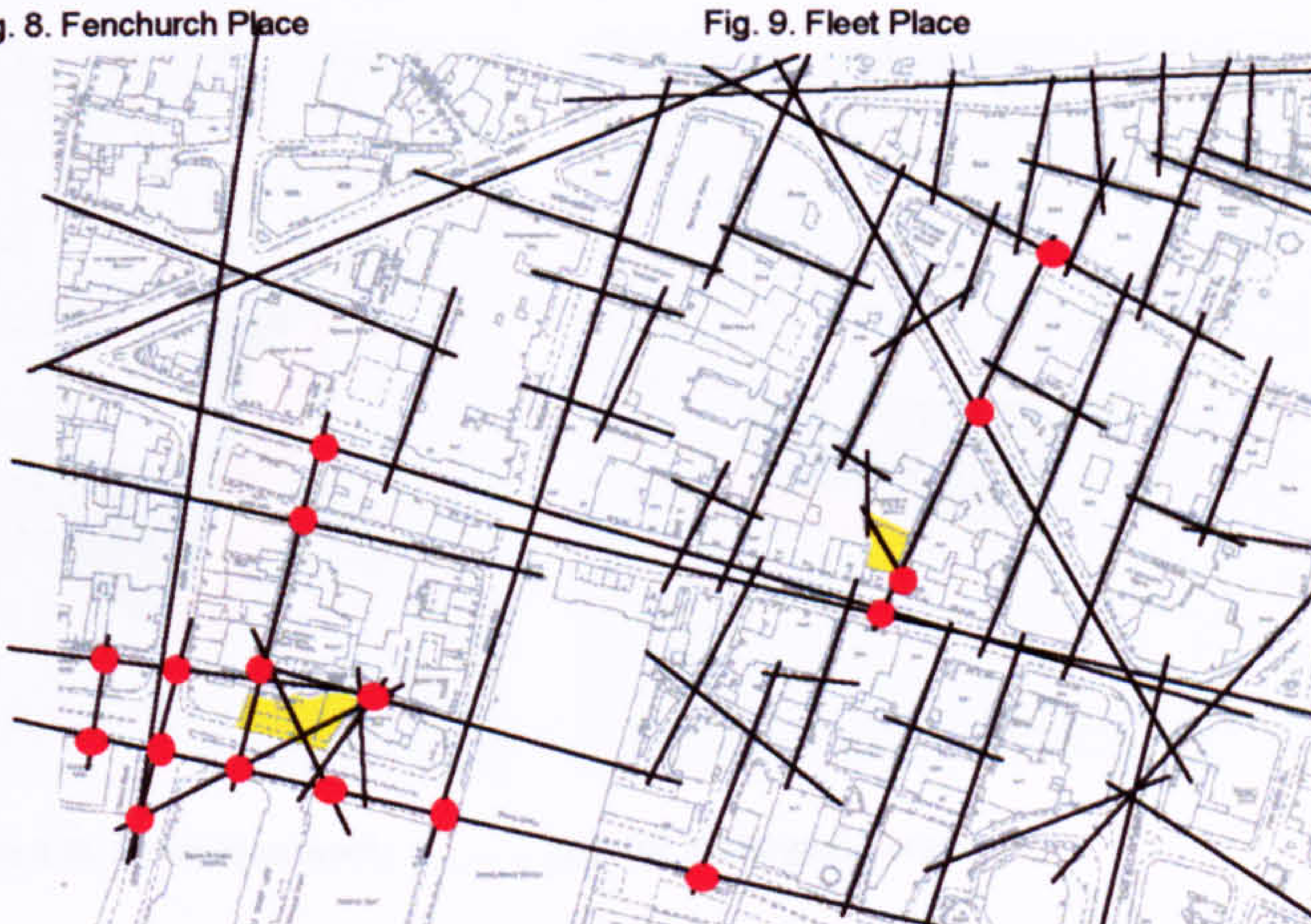


Fig. 11. Whittington Gardens and Fig. 12. Abchurchyard

Plate 6.23. Overlapping point isovists maps

scale: 1:2500

maximum coverage density — minimum coverage density

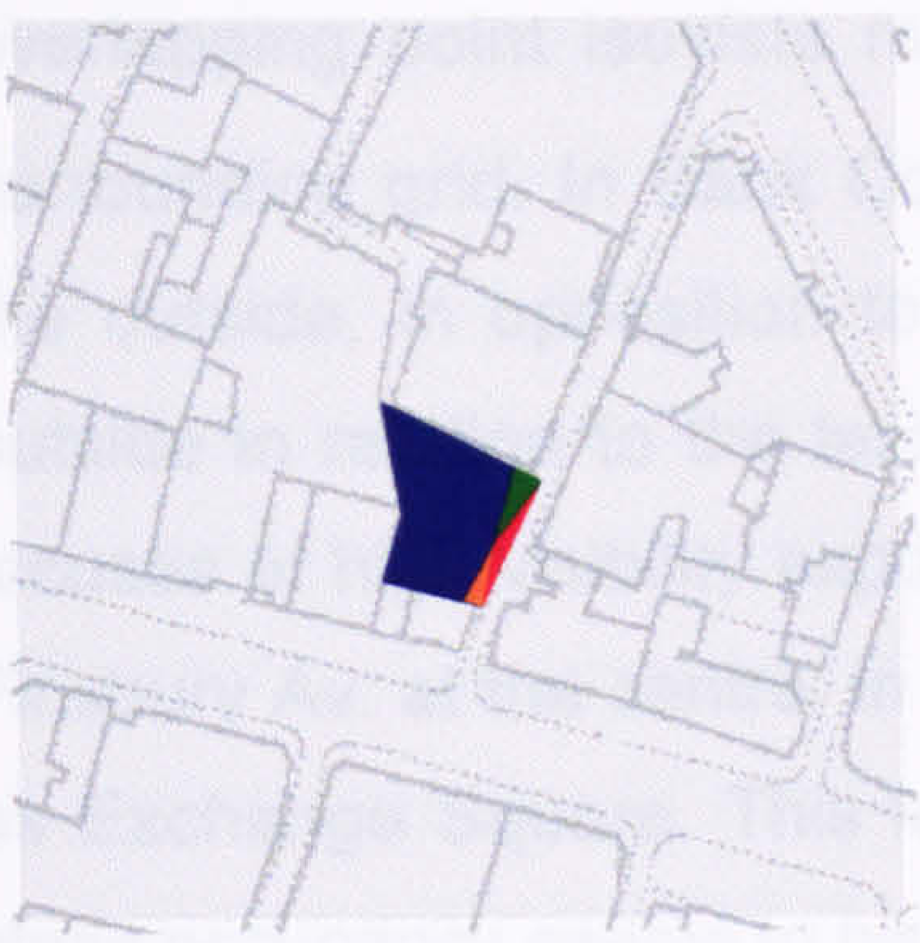


Fig. 1. Abchurchyard

Fig. 2. Bank Corner

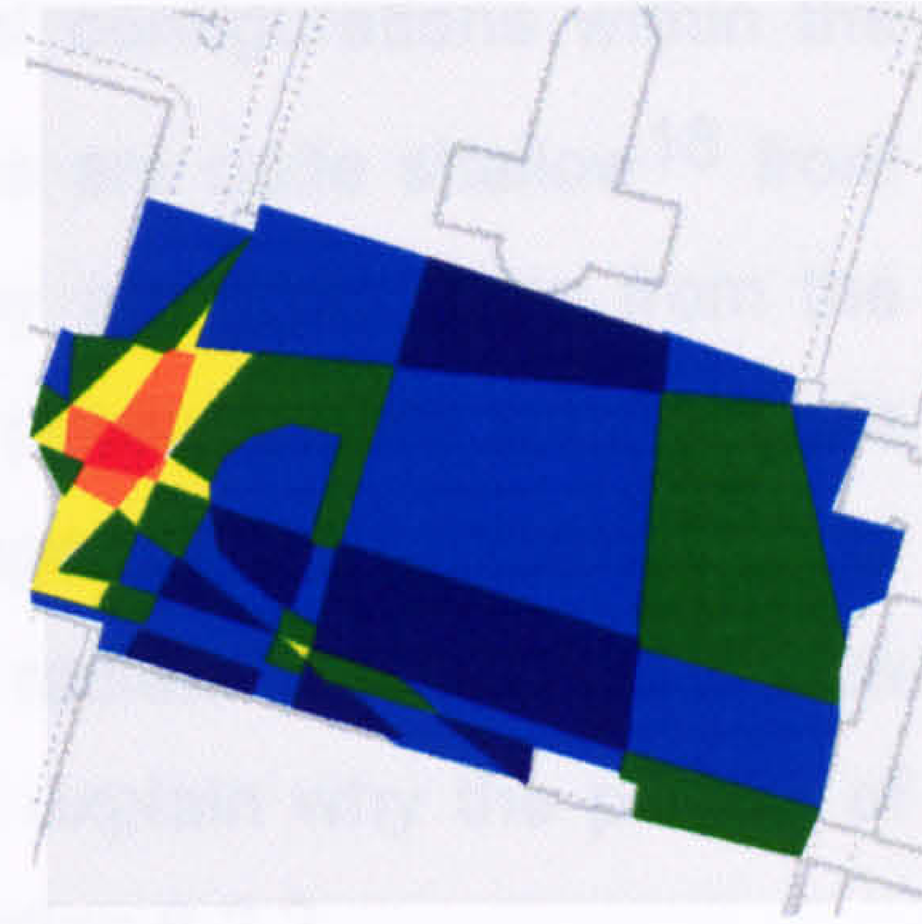


Fig. 3. Exchange Square

Fig. 4. Fenchurch Place

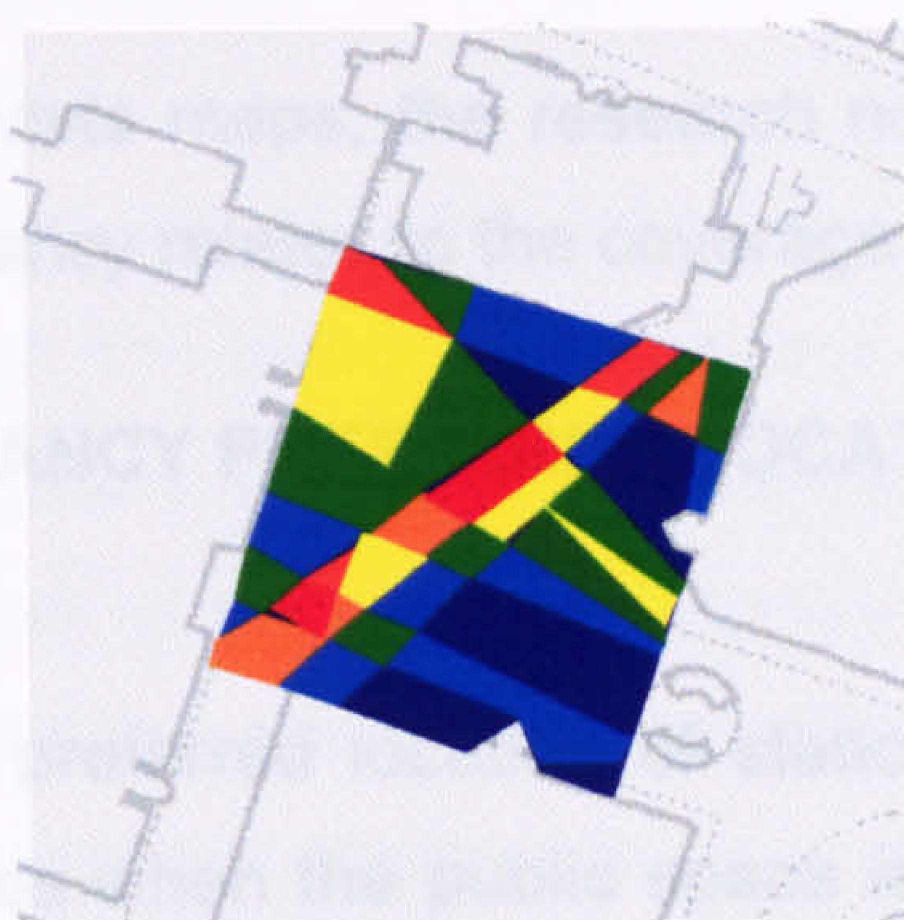


Fig. 5. Finsbury Av.

Fig. 6. Fleet Place

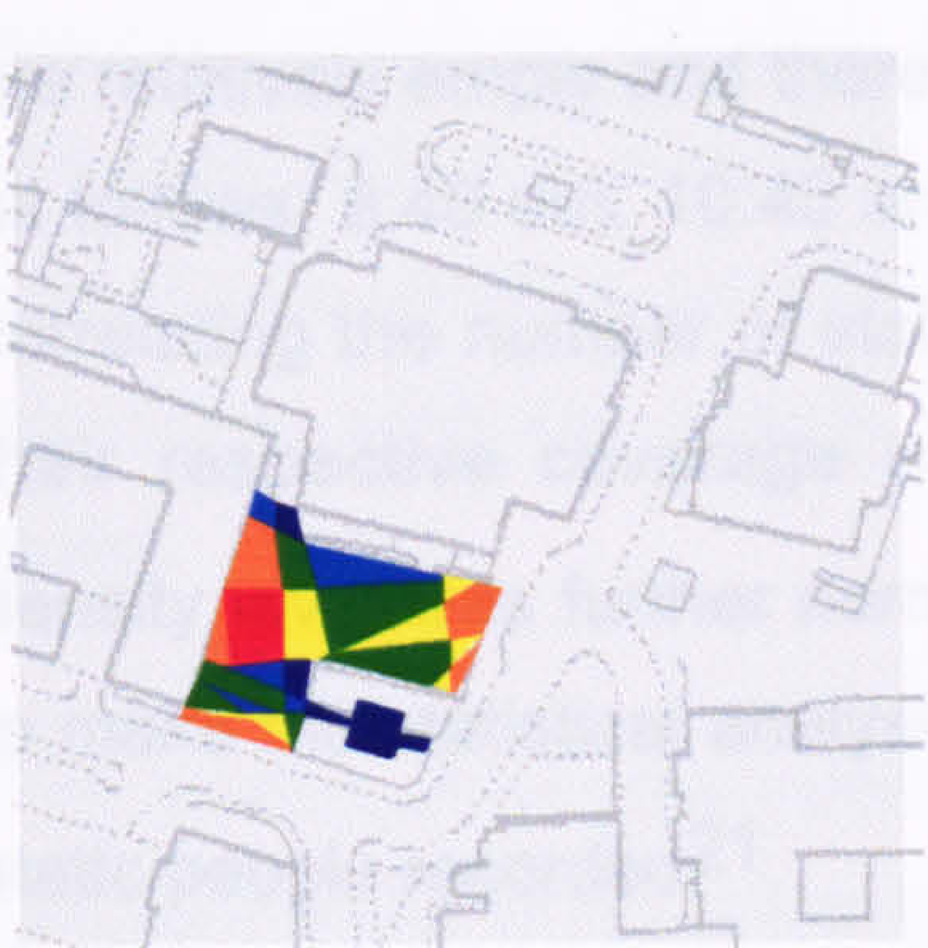


Fig. 7. Love Lane Corner

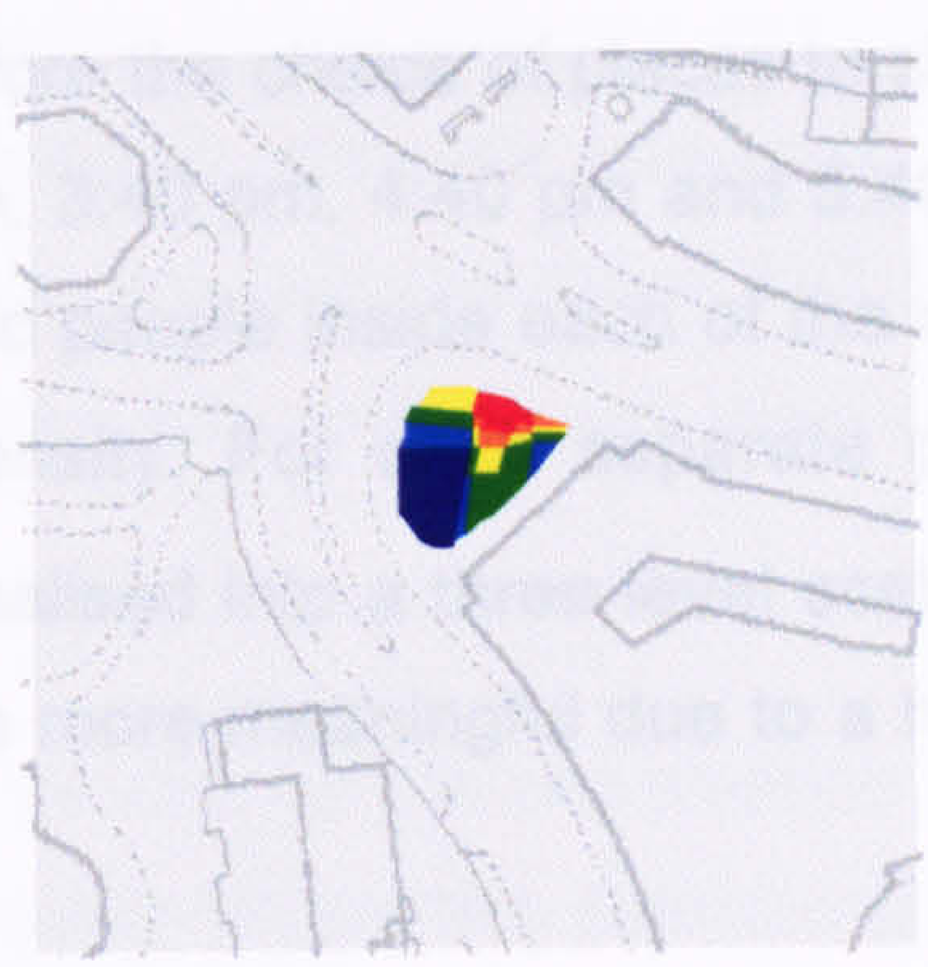


Fig. 8. New Change/Cheapside Corner

Fig. 9. North Guildhall

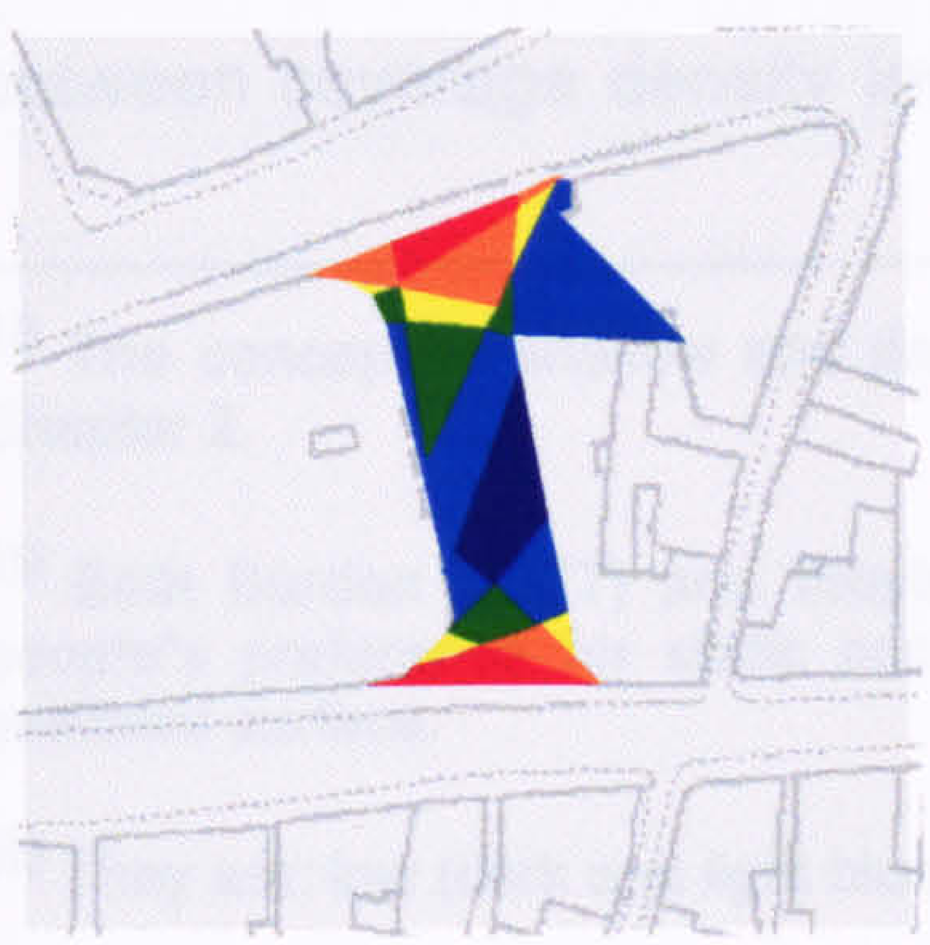


Fig. 10. Royal Exchange

Fig. 11. St. Anne & St. Agnes churchyard

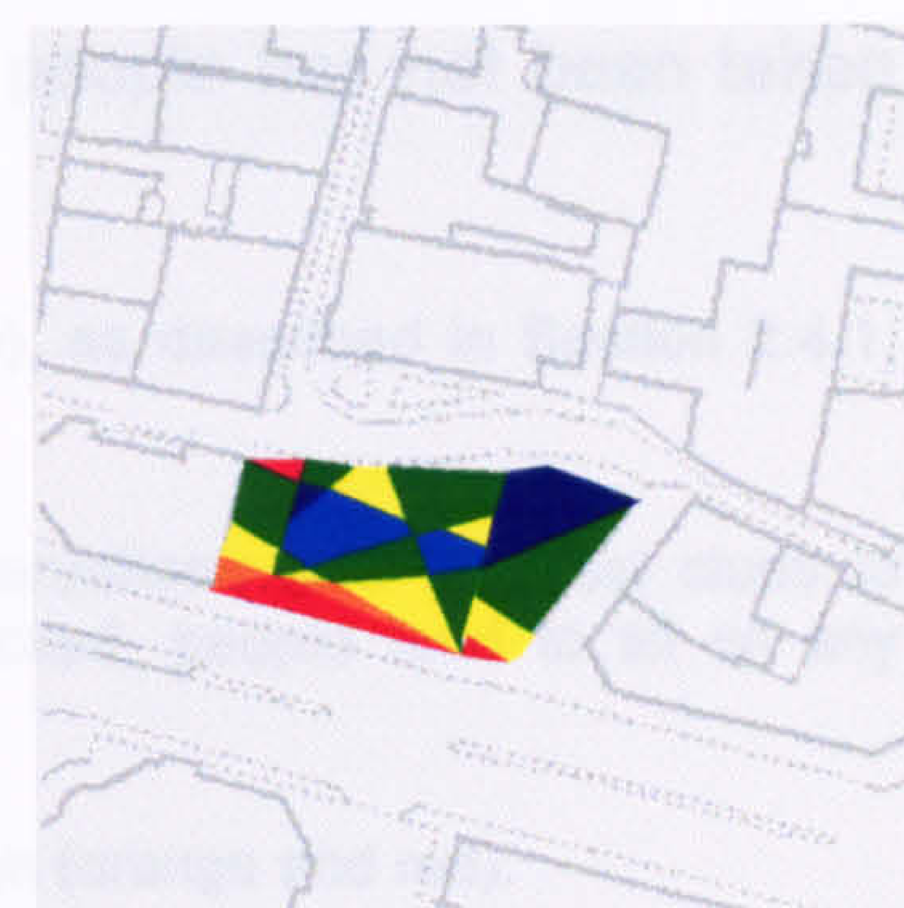


Fig. 12. Whittington Gardens

On comparison of Bank Corner and Fenchurch Place (Figs. 2 and 4, Plate 6.23), we can see how public spaces with similar spatial layouts can have very distinctive overlapping point isovists maps, that is, distinctive visual configurations within the surrounding grid. In Bank Corner, the most exposed areas are quite shallow[18] from the outside, in opposition to Fenchurch Place where they are quite deep from the outside in relation to the less exposure areas. There are public spaces with multiple focuses of high visibility exposure areas like Royal Exchange Square at both ends, or Finsbury Av. at the centre, in contrast to public spaces that radiate from one point such as Exchange Square. This is significant because it might explain why the pattern of static occupancy seems to be so diverse as described in Section 6.2.2.

Based on the overlapping isovists maps, the research now investigates whether and how the pattern of static occupancy relates to the coverage density of convex spaces.

6.2.4. STATIC OCCUPANCY PREFERRED LOCATION: THE SPATIAL ANALYSIS

This section will address the preferred location of static people in public spaces by examining only the time periods when the public space is partially used. The analysis focused on five different times (off peak for static occupancy) where the public spaces are relatively empty and therefore the choice of places to sit or stand are maximised[19], as follows: 8:40 am, 10:40 am, 3:40 pm, 4:40 pm and 5:40 pm. The analysis starts by correlating the number of static people inside each of the resulting convex spaces and their respective coverage density. For each separate public space, the coverage density level was further normalised into a three level scale (low, medium and high)[20] to make the statistical analysis more meaningful due to a high number of areas with no static people recorded[21].

At this stage, the effect of the geometric area of the convex spaces on the relationship between coverage density levels and the number of static people has not been taken

[18] The concept of shallow and deep is based on Hillier et al. (1987b), as described in Section 2.4.1, Chapter 2.

[19] Both Burden (1977) and Whyte (1980) confirm that off-peak observations give the best clues to people's preference for static occupancy, since when a place is packed, people tend to sit on any available surface.

[20] They are: low (dark and light blue), medium (green and yellow) and high (orange and red).

[21] During the off-peak time it was possible that no one would be observed.

into account. As previously discussed in Chapter 5, the research has shown that for the public spaces in the City of London, the level of static occupancy is a function of the strategic value, that is, the diffusion of pedestrian movement in adjacent areas. In addition, the results have shown that the number of static people is not a function of the area of the public space as illustrated by both the simple (see Figure 5.52 in Chapter 5) and stepwise regression analyses (Plate 5.19 in Appendix 3). Also, the analysis showed no relationship between levels and density of static occupancy. Therefore, it is proposed that the analysis of the distribution of static people inside public spaces should not be measured based only on density (this point will be further examined in Section 6.2.4), but simply on the relationship between the number of static people and the coverage density levels.

In order to investigate to what extent static behaviour is related to the degree of visibility connections between the public spaces and the urban environment, the analysis of the occupation of public spaces will be carried out in two phases. The first phase looks at the total number of static people independent of the activities that the people were engaged in. In addition, the data is quantified and analysed separately for each observation day to investigate whether there is a systematic pattern of static occupancy. The second phase classifies the number of static people according to three selected activities: relaxing, eating and/or drinking and reading. The idea is to explore whether different activities require different locations. Specifically, the aim is to investigate whether people who are relaxing are in fact more likely to select exposed locations, whereas people who are reading will deliberately select more secluded areas.

The investigation was made by plotting the observation data for convex spaces with different levels of coverage density for the five selected time periods over the two days of observation. For each coverage density band, the number of static people was counted and divided by the number of times that the data was collected. The results are illustrated in Table 6.4. Plates 6.24 and 6.25 (Appendix 4) give a sample of the data used in the analysis.

Public space name	Observation day	Mean number of static people		
		Low	Medium	High
Abchurchyard	day 1	2.00	0.80	0
Abchurchyard	day 2	1.80	1.00	0
Bank Corner	day 1	9.00	6.75	1.50
Bank Corner	day 2	8.25	7.00	0.50
Exchange Sq.	day 1	14.60	4.20	0
Exchange Sq.	day 2	32.60	29.20	0.60
Fenchurch	day 1	3.80	4.20	4.80
Fenchurch	day 2	1.20	3.60	2.60
Finsbury Av.	day 1	12.60	59.80	9.00
Finsbury Av.	day 2	1.00	4.20	1.00
Fleet Place	day 1	2.20	3.00	0.80
Fleet Place	day 2	4.60	3.00	0
Love Lane	day 1	0.80	0.80	1.60
Love Lane	day 2	0.80	0.40	0.80
New Change	day 1	4.40	2.00	0.60
New Change	day 2	2.20	1.60	0.40
North Guildhall	day 1	1.20	0.20	1.00
North Guildhall	day 2	2.00	0	0.40
Royal Exchange	day 1	11.75	9.00	0.25
Royal Exchange	day 2	11.75	10.75	2.00
St.Anne/ St.Agnes	day 1	2.20	0.60	0.60
St.Anne /St.Agnes	day 2	1.40	0	0.20
Whittington gds	day 1	2.80	21.00	20.00
Whittington gds	day 2	0.80	5.40	5.00

Table 6.4. Mean number of static people according to convex spaces and respective coverage density levels and days

Figures 6.15 and 6.16 illustrate the procedure, using the six-band coverage density scale, for Bank Corner and Fenchurch Place. The data is shown for day 1, 10:40 am, with men represented in blue and women in red.

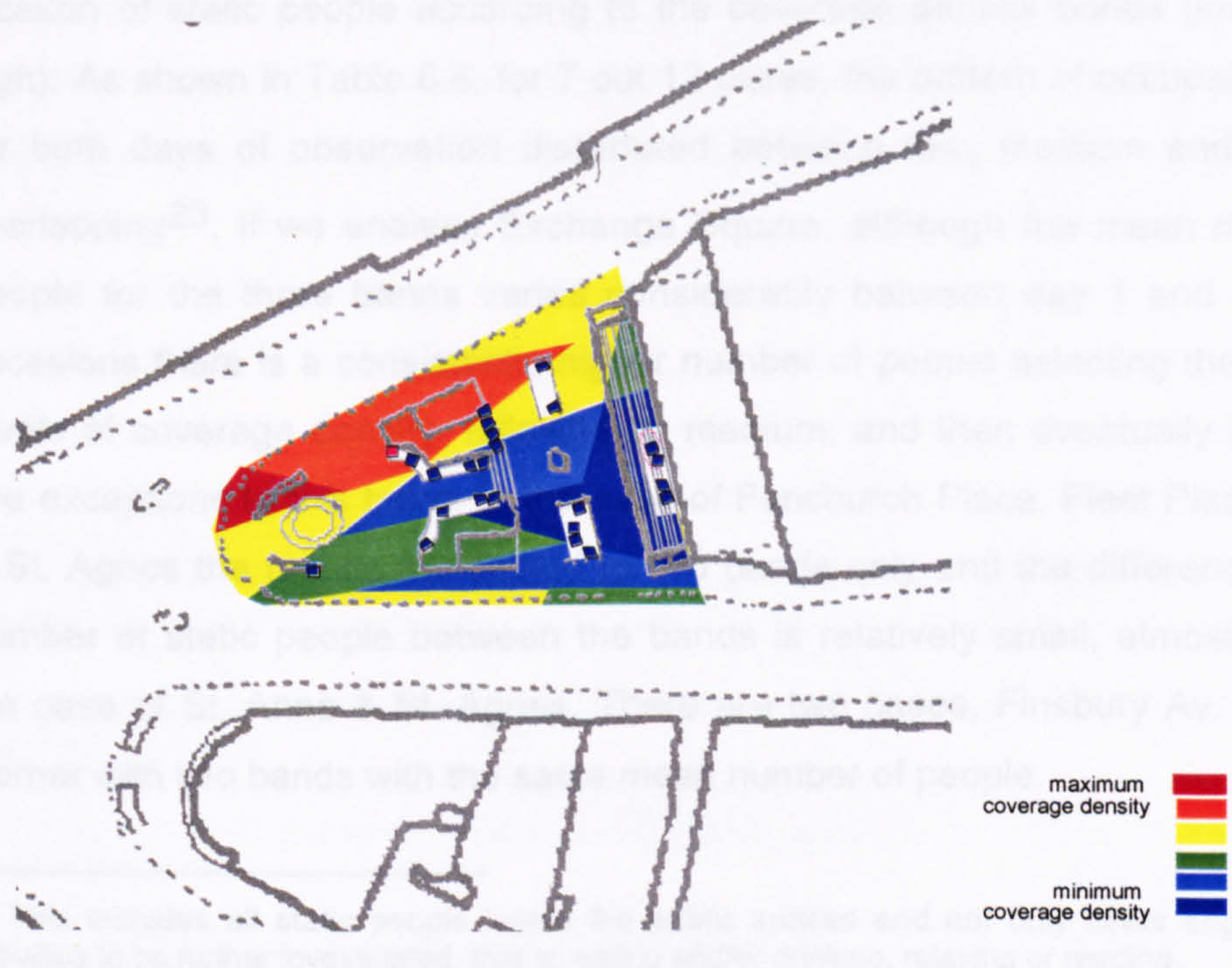


Figure 6.15. Bank Corner static occupancy and overlapping point isovists map

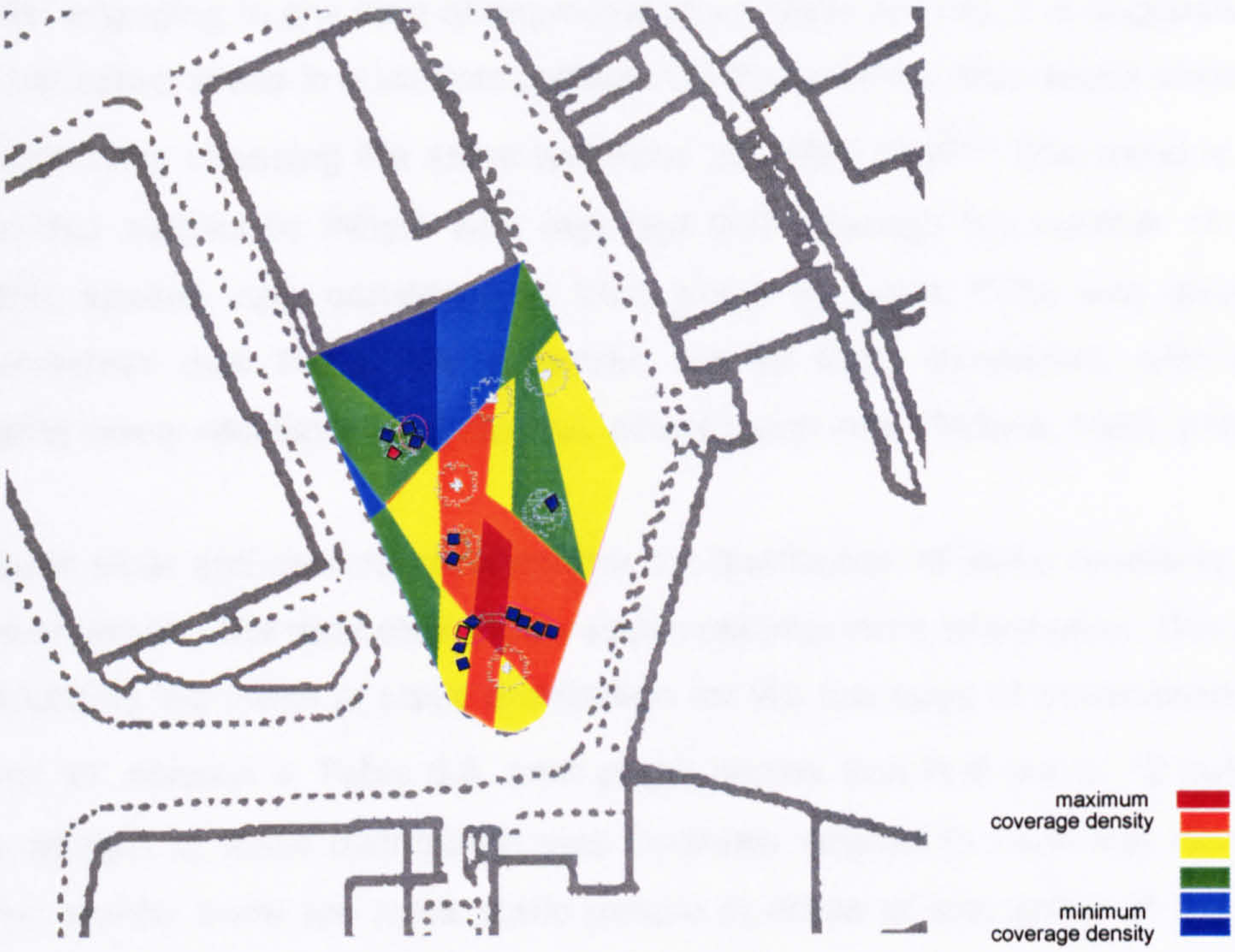


Figure 6.16. Fenchurch Place static occupancy and overlapping point isovists map

When inspecting the total number of all static people observed for each day[22] that the data was collected, we can see that there is a very high consistency in the preferred location of static people according to the coverage density bands (low, medium and high). As shown in Table 6.4, for 7 out 12 cases, the pattern of occupation is the same for both days of observation distributed between low, medium and high levels of overlapping[23]. If we analyse Exchange Square, although the mean number of static people for the three bands varies considerably between day 1 and day 2, on both occasions there is a consistently higher number of people selecting the areas with low levels of coverage density, followed by medium, and then eventually high. There are five exceptions to this trend. In the case of Fenchurch Place, Fleet Place and St. Anne & St. Agnes the results are limited to two bands only and the difference for the mean number of static people between the bands is relatively small, almost insignificant in the case of St. Anne & St. Agnes. There are two cases, Finsbury Av. and Love Lane Corner with two bands with the same mean number of people.

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[22] This includes all static people inside the public spaces and not only users engaged in the three activities to be further investigated, that is, eating and/or drinking, relaxing or reading.

[23] So far there is no attempt to suggest which areas are preferred for unprogrammed static occupancy.

These results illustrate a very important finding. When selecting areas to sit or stand whilst engaging in any kind of unprogrammed static activity, it is suggested that people do not select areas in a random pattern. On the contrary, the results show that different people keep choosing the same locations day after day[24]. This trend is supported by previous studies by Whyte who reported that although the number of people inside public spaces vary considerable from place to place, "The way people distribute themselves over the space, however, will be fairly consistent, with some sectors getting heavy use day in and day out, others much less" (Whyte, 1980, p18).

A quite clear and consistent pattern for the distribution of static people in public spaces has emerged. The data also shows additional important information. The analysis, after calculating the mean of static distribution for the two days of observation (seen for the "total all" column in Table 6.5, next page) shows that in 6 out of 12 public spaces[25], the pattern of static distribution was inversely related to coverage density levels. In other words, there are more static people in areas of low levels of overlapping point isovists, followed by medium levels and finally in high levels of overlapping isovists. There are two examples, North Guildhall and St. Anne & St. Agnes churchyard, where areas of low coverage density are again the preferred location for static people, although followed by high levels of coverage density[26]. There is only one case, Love Lane Corner where the preference of static people was for areas with high levels of coverage density. Although there are three public spaces where the majority of static people chose convex spaces with medium levels of overlapping[27], the data revealed that in seven public spaces[28], the most exposed spaces were the least popular.

[24] As discussed previously, the data on static occupancy was recorded for two different days randomly selected. The time span between day 1 and day 2 was on average ten days.

[25] They are: Abchurchyard, Bank Corner, Exchange Square, Fleet Place, New Change/Cheapside Corner and Royal Exchange.

[26] For St. Anne & St. Agnes churchyard, levels of static distribution for medium and high coverage density levels is the same.

[27] They are: Fenchurch Place, Finsbury Av. and Whittington Gardens.

[28] They are: Abchurchyard, Bank Corner, Exchange Square, Finsbury Av., Fleet Place, New Change/Cheapside Corner and Royal Exchange.

Public space name	Mean number of static people		
	Low	Medium	High
Abchurchyard	1.90	0.90	0.00
Bank Corner	8.63	6.88	1.00
Exchange Sq.	23.60	16.7	0.30
Fenchurch	2.50	3.90	3.70
Finsbury Av.	6.80	32.00	5.00
Fleet Place	3.40	3.00	0.40
Love Lane	0.80	0.60	1.20
New Change	3.30	1.80	0.50
North Guildhall	1.60	0.10	0.70
Royal Exch.	11.75	9.88	1.13
St.Anne & St. Agnes	1.70	0.40	0.40
Whittington	1.80	13.20	12.50
MEAN ALL CASES	5.65	7.44	2.24

Table 6.5. Mean number of static people according to areas and respective coverage density levels

When all the data was analysed together, the findings suggest, surprisingly, that people's preferred location actually follows a distinct pattern, with people selecting more secluded areas compared to the exposed ones for unprogrammed static activities. The mean number of static people for all cases showed a preference for locations with medium levels of exposure, followed by low levels followed by high levels of coverage density (Table 6.5). However, in the sample there is a mixture of public spaces with and without catering facilities. If we take the case of Finsbury Av. as an example since there is a large difference in the numbers of static people in the areas of medium levels of visual exposure compared to the remaining two levels, we can see, as illustrated in Figure 6.17, that the vast majority of people in the public space for the 4:40 pm time period, are wine bar users. Whatever the reasons are for the wine bar to be located where it is, the users tend to stay near it, which, in this case, is facing areas of medium levels of coverage density. Quite often, the wine bars also provide street furniture in the form of tables and seats and generally these are for the exclusive use of their clients. Not only does this restrict the places where the users may stay (that is, close to the wine bar), but also it prevents the non-wine bar users from being near it. In the case of Finsbury Av., we can see that the remaining users of the public space are actually located in areas of low coverage density levels.

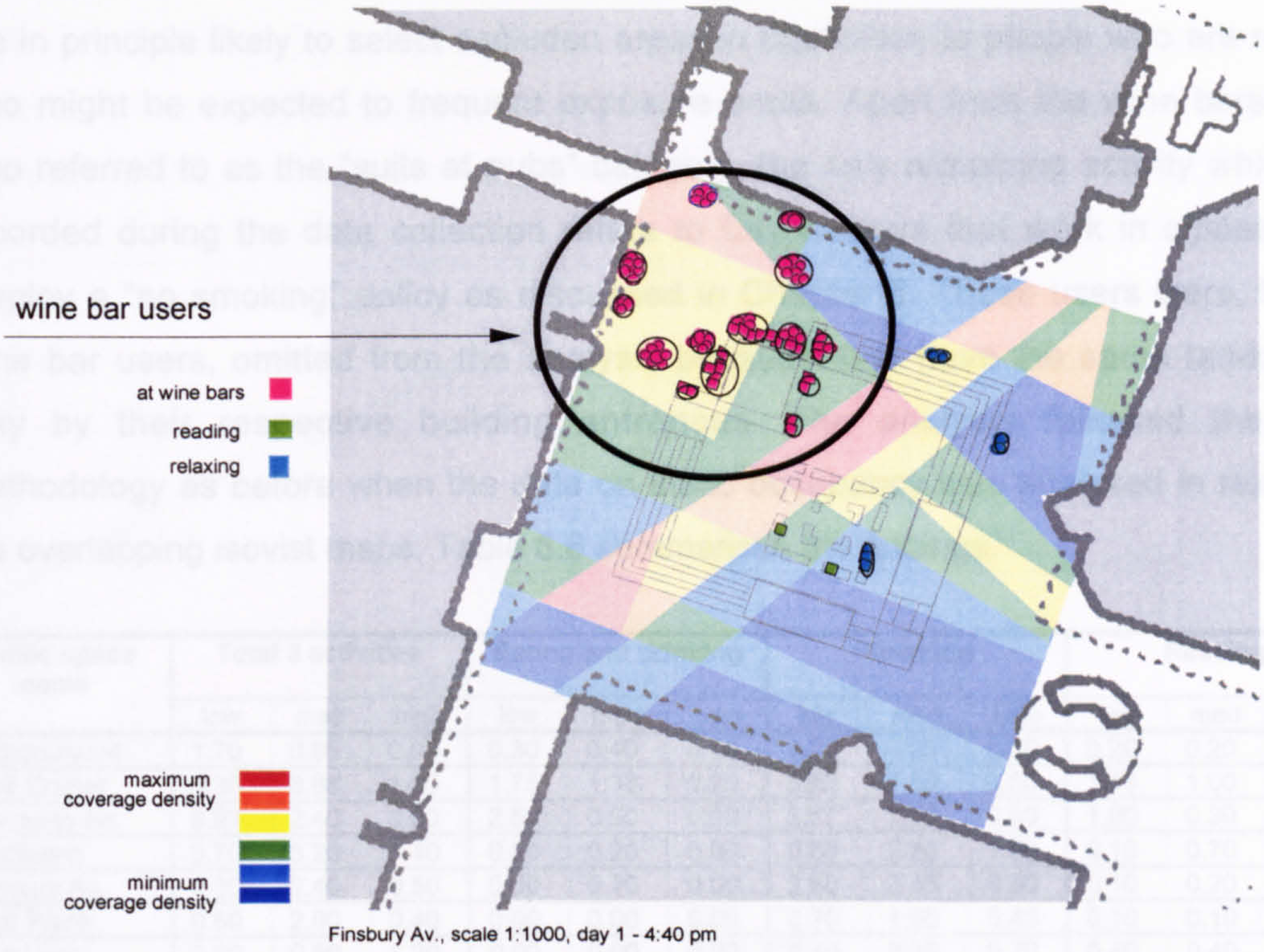

Figure 6.17. Finsbury Av. static occupancy and overlapping isovists convex spaces

Therefore, the wine bar users should be omitted, in order to see whether the pattern of static occupancy is inversely related to the increasing degree of visual connections to the surrounding grid of the public space convex areas, as initially suggested. This will be dealt by separating the data according to different user activities.

6.2.4.1. Static distribution according to three activities: eating and/or drinking, relaxing or reading

The distribution of static people was examined according to three specific activities; eating and/or drinking, relaxing or reading. The eating and/or drinking category contains all those who were either eating a sandwich or drinking a coffee, with food bought elsewhere. The reading category involves people who are either reading or engaged in any activity that requires mental concentration, such as writing a letter or work related issues. The relaxing category includes people who were on their own or looking at people walking by or talking to friends but who were not engaged in any other activity. These three activities summarise all functions that people occupy themselves with in public spaces[29]. In addition, they also characterise activities that

[29] These findings are confirmed by two separate studies on people's activities in public spaces that claim that eating, reading, watching and listening accounts for more than 90% of all use (Marcus and Francis, 1990, p9 and Korosec-Serfaty, 1982).

are altogether different from each other. It is conjectured that people who are reading are in principle likely to select secluded areas in opposition to people who are relaxing who might be expected to frequent exposure areas. Apart from the wine bars users, also referred to as the "suits at pubs" category, the only remaining activity which was recorded during the data collection refers to City workers that work in offices which employ a "no smoking" policy as discussed in Chapter 5. Those users were, like the wine bar users, omitted from the analysis because they have the same tendency to stay by their respective building entrances. The analysis followed the same methodology as before when the data on static occupancy was analysed in relation to the overlapping isovist maps. Table 6.6 summarises the findings.

Public space name	Total 3 activities			Eating and drinking			Relaxing			Reading		
	low	med	high	low	med	high	low	med	high	low	med	high
Abchurchyard	1.70	0.80	0.00	0.30	0.40	0.00	1.20	0.20	0.00	0.20	0.20	0.00
Bank Corner	8.38	6.88	1.00	1.75	1.38	0.25	5.50	4.50	0.50	1.13	1.00	0.25
Exchange Sq.	9.97	2.40	0.00	2.50	0.90	0.00	5.57	1.30	0.00	1.90	0.20	0.00
Fenchurch	0.70	3.20	2.40	0.00	0.20	0.00	0.60	2.30	1.90	0.10	0.70	0.50
Finsbury Av.	2.60	2.40	0.50	0.00	0.20	0.00	2.50	2.40	0.50	0.10	0.20	0.00
Fleet Place	0.80	2.00	0.40	0.00	0.00	0.00	0.70	1.90	0.40	0.10	0.10	0.00
Love Lane	0.80	0.60	1.20	0.00	0.00	0.20	0.40	0.20	0.70	0.40	0.40	0.30
New Change	0.50	0.60	0.30	0.00	0.10	0.00	0.40	0.20	0.20	0.10	0.30	0.10
North Guildhall	1.60	0.10	0.70	0.00	0.00	0.00	1.00	0.10	0.70	0.60	0.00	0.00
Royal Exch.	7.38	2.13	1.13	2.75	1.50	0.13	4.00	0.63	0.88	0.63	0.00	0.13
St.Anne	1.70	0.40	0.40	0.60	0.00	0.00	0.90	0.30	0.30	0.20	0.10	0.10
Whittington	1.80	4.80	0.70	0.40	1.50	0.00	1.40	2.80	0.70	0.00	0.50	0.00
MEAN ALL CASES	3.15	2.22	0.72	0.69	0.51	0.05	2.01	1.40	0.56	0.45	0.31	0.11

Table 6.6. Mean number of static people according to areas and respective coverage density levels for different activities

From the data in Table 6.6, examining the results in the "mean all cases" row, when all the data for static people was analysed for all locations, it is suggested that different activities are not restricted to particular locations. There was no strong evidence to support that people relaxing would select more exposure areas or that people reading would deliberately select secluded areas. For all three activities, it is suggested that the location of static people is associated to the visual connectivity between the open spaces and the surrounding grid.

Bank Corner is a very representative example of the general trends. Figure 6.18 shows the static occupancy classified according to the three activities. If we look at the diagram where all static people are located, we can see two groups sitting on the steps of the Royal Exchange building (highlighted by the black circle) but they are involved in different activities. There is one group that is relaxing and the other one falls into the eating and/or drinking category. In addition, if we restrict the analysis to the relaxing category, represented by the light blue squares, we can see that the four individuals that fall into this category are located in areas of different coverage density. Three in the medium coverage density area (yellow and green) and one in the low density area (light blue). The same trend is found for the remaining two activities.

Figure 6.18. Bank Corner static occupancy and overlapping isovist convex spaces according to activities

If we focus at only one specific activity, such as relaxing, only in Love Lane Corner (Table 6.6) do the majority of people clearly select highly exposed spaces. In three of the public spaces the most popular areas for relaxing were areas with medium levels of coverage density[30], whilst in all the remaining eight cases the preferred location for relaxing activities was areas with a low degree of exposure.

The results suggest that, overall, the activities that people might engage in are not a dominant factor when choosing locations to sit or stand. Reading is the only activity that possibly follows the expected trend, according to studies presented in the literature review, with low levels of visual connections to the surrounding areas. But, because the overall pattern of static occupancy has already indicated that low exposure areas are favoured independently of the activity involved, it is more likely to be a general trend rather than to be specific to the activity itself. In fact, when the data was analysed

30 They are: Fenchurch Place, Fleet Place and Whittington Gardens.

against the individual cases (eating and/or drinking, relaxing and reading), the study showed that the pattern for all three activities often tend to be the same for the same public space. For example, looking at the results of Bank Corner and Exchange Square and St. Anne & St. Agnes churchyard, as described in Table 6.6, people relaxing and/or people watching, eating or drinking and reading all prefer to sit first in areas of low levels of coverage density, followed by medium and then high levels of coverage density. In other four cases[31], there is only one activity that does not follow the general pattern of distribution of static people.

We can further assess the data by comparing the percentage of mean number of static people according to activities and location summarised in Table 6.7.

Categories	Mean n° low	Mean n° medium	Mean n° high	Mean n° total	Percent. low	Percent. medium	Percent. high	Percent. total
Eating	0.69	0.51	0.05	1.25	55.20	40.80	4.00	100.00
Relaxing	2.01	1.40	0.56	3.97	50.63	35.26	14.11	100.00
Reading	0.45	0.31	0.11	0.87	51.72	35.63	12.65	100.00
3 activities	3.15	2.22	0.72	6.09	51.72	36.45	11.83	100.00
All (including drinking at pubs)	5.65	7.44	2.24	15.33	36.85	48.53	14.62	100.00

Table 6.7. Sample mean number and percentage of static people according to coverage density levels for different activities

From Table 6.7 (when wine bar users and office smokers are omitted) when the mean for the twelve cases was calculated, there is a clear preference for all activities of static occupancy to be inversely related to the level of coverage density. In fact, for all three activities, the percentages according to the different areas of visual exposure are remarkable similar. For the convex spaces with low levels of overlapping isovists (for all three activities) not only do these areas receive the majority of static occupancy but also the percentage is close to the 50% mark[32]. Similarly, for the convex areas with medium level of coverage density the percentage is around 37% for all cases. Only when we look at the areas with high levels of exposure is there a significantly low percentage (4%) for the eating category compared to the other two (sample mean is 11.83%) and a small higher percentage for the relaxing category. Nevertheless, this is still consistent with the general trend on preferred areas for static occupancy.

[31] They are: Fenchurch Place, New Change/Cheapside Corner, Royal Exchange and Whittington Gardens.

[32] The percentage is calculated by dividing the total mean number of (eating) people for low coverage density (0.69) by the total mean number of people (1.25) and so on.

The data also show, as seen in Table 6.8, for the whole day[33], relaxing (58.41%) is the most common activity in public spaces, when wine bar users are omitted, followed by eating with 27.42%[34] and finally reading with 14.17%. This is in line with the findings for the different activities when these are investigated throughout the sample. When these three activities are compared for all time periods, relaxing is the most common activity, even when the analysis is restricted to the lunchtime period.

Categories	Number all day	Number lunchtime	Number all day but lunchtime	Percentage all day	Percentage lunchtime	Percentage all day but lunchtime
Eating	3297	2473	824	27.42	35.99	16.00
Relaxing	7022	3510	3512	58.41	51.08	68.18
Reading	1704	889	815	14.17	12.93	15.82
Total	12023	6872	5151	100.00	100.00	100.00

Table 6.8. Sample number and percentage of static people according to time periods

These results confirm previously discussed ideas[35] that people seem to avoid very exposed spaces and prefer areas that provide good views but still have some privacy, although it has not been possible as yet for this to be properly quantified. We can conclude that, having arrived at the public spaces through the global properties of the urban grid, people's preferred location follows a reverse order with a preference for more secluded areas for unprogrammed static occupation.

The detail visual inspection of the data (exemplified in Plates 6.24 and 6.25 in Appendix 4)[36], also suggests an important second underlining trend. When considering all the areas of low coverage density, the ones which seem to receive the majority of static people are the ones close to (or in the view of) areas of high coverage density. Likewise, the same behaviour seems to be found for the areas of medium coverage density levels. A typical example is illustrated in Figure 6.19.

33 In this case, the data collected for all time periods, as described in Section 5.2.1 (Chapter 5) was used in the analysis.

34 Plummer and Shewan's (1985) survey on uses of public spaces had showed that 22% of the observed people were eating.

35 See Section 2.6, in Chapter 2.

36 The data used in the analysis was based on all snap shot maps illustrated in Plates 6.9 to 6.20 (Appendix 4). Plates 6.24 and 6.25 represent a sample of the data used in the analysis.

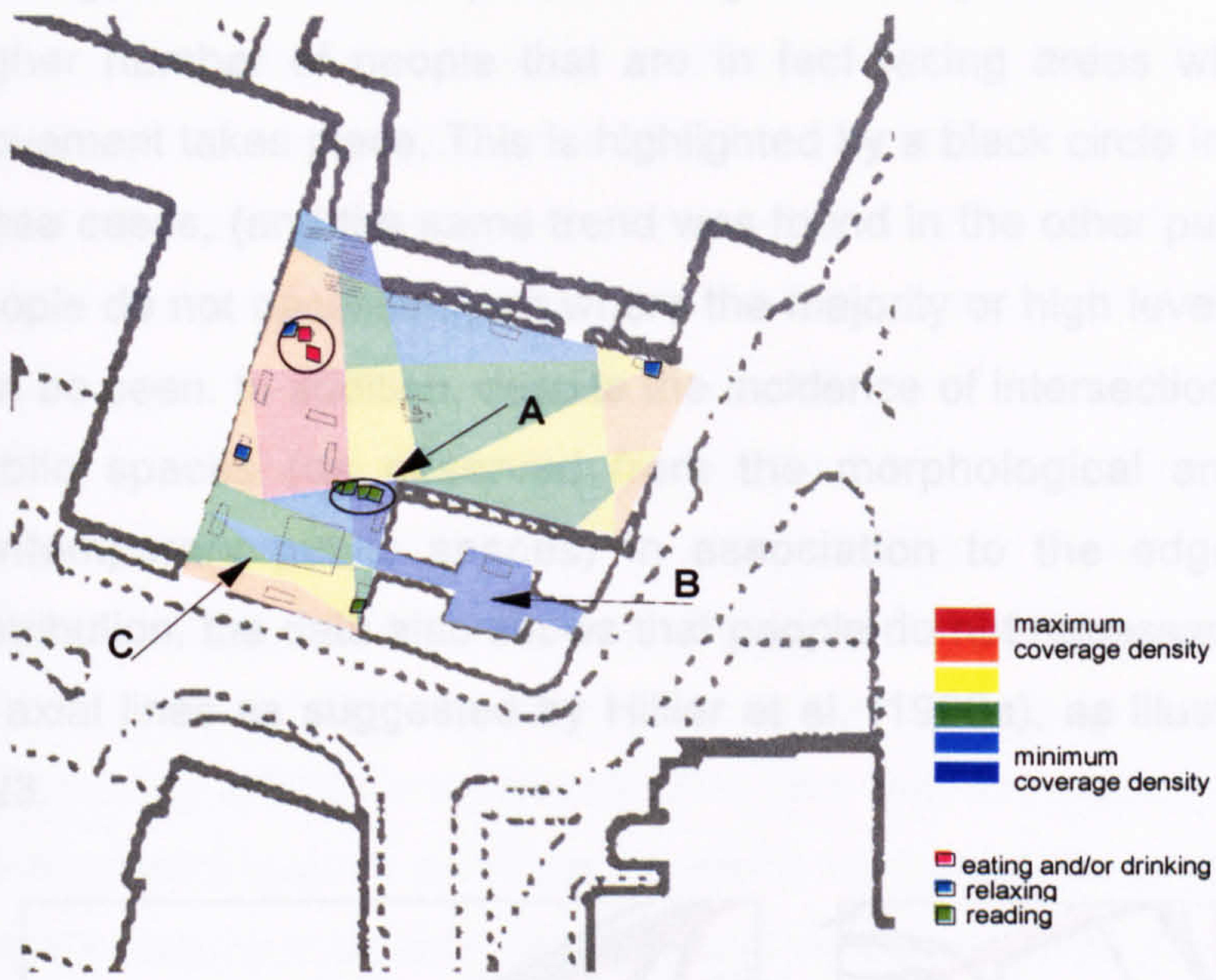

Figure 6.19. Love Lane Corner static occupancy and overlapping isovist convex spaces
Scale: 1:1000, day 1, 10:40 am

In this diagram (Fig. 6.19) we can see a group of four people of the reading category (represented by small green squares) who have positioned themselves in a particular low coverage density area (highlighted by arrow A) in preference to another adjacent area (highlighted by arrow B). This could be explained by the tendency of users to place themselves in areas within the field of view from where they accessed the public space, that is, the entry point (in this case illustrated by arrow C). This is particularly exemplified in the case of public spaces with complex internal layouts (high vegetation or walls that can shield the view of other remaining areas) or irregular geometric shapes where only limited areas of the public space are seen from each of the entry points. Therefore, this supports the theory that people do not place themselves necessarily where the largest isovists are, but within a broader visual field from the entry point. However, within this visual field, there is strong preference for areas which provide a certain degree of privacy but still within the view of the entry points.

6.2.4.2. Pedestrian flow

From the literature review, it has been suggested that people's preferred locations are the ones that face the pedestrian flow. The data is therefore analysed to see whether static distribution may also be associated with high levels of pedestrian movement. Bank Corner (Fig. 6.20) and Fenchurch Place (Fig. 6.21) are selected to clarify this, using the data shown for day 1, 10:40 am. As we can see from Figures 6.20 and 6.21, although there are static people facing the main pedestrian flow, there is a substantially higher number of people that are in fact facing areas where the least pedestrian movement takes place. This is highlighted by a black circle in both examples. Clearly in these cases, (and the same trend was found in the other public spaces of the sample) people do not necessarily sit where the majority or high levels of pedestrian movement can be seen. In addition, despite the incidence of intersection points at the periphery of public spaces (as observed from the morphological analysis of traditional and contemporary public spaces) in association to the edge effect of static people distribution, the data also shows that people do not necessarily sit near the intersection of axial lines as suggested by Hillier et al. (1990a), as illustrated in Figures 6.22 and 6.23.

Figure 6.20. Bank Corner static occupancy and movement trace (scale 1:1500)

Figure 6.21. Fenchurch Place static occupancy and movement trace (scale 1:1500)

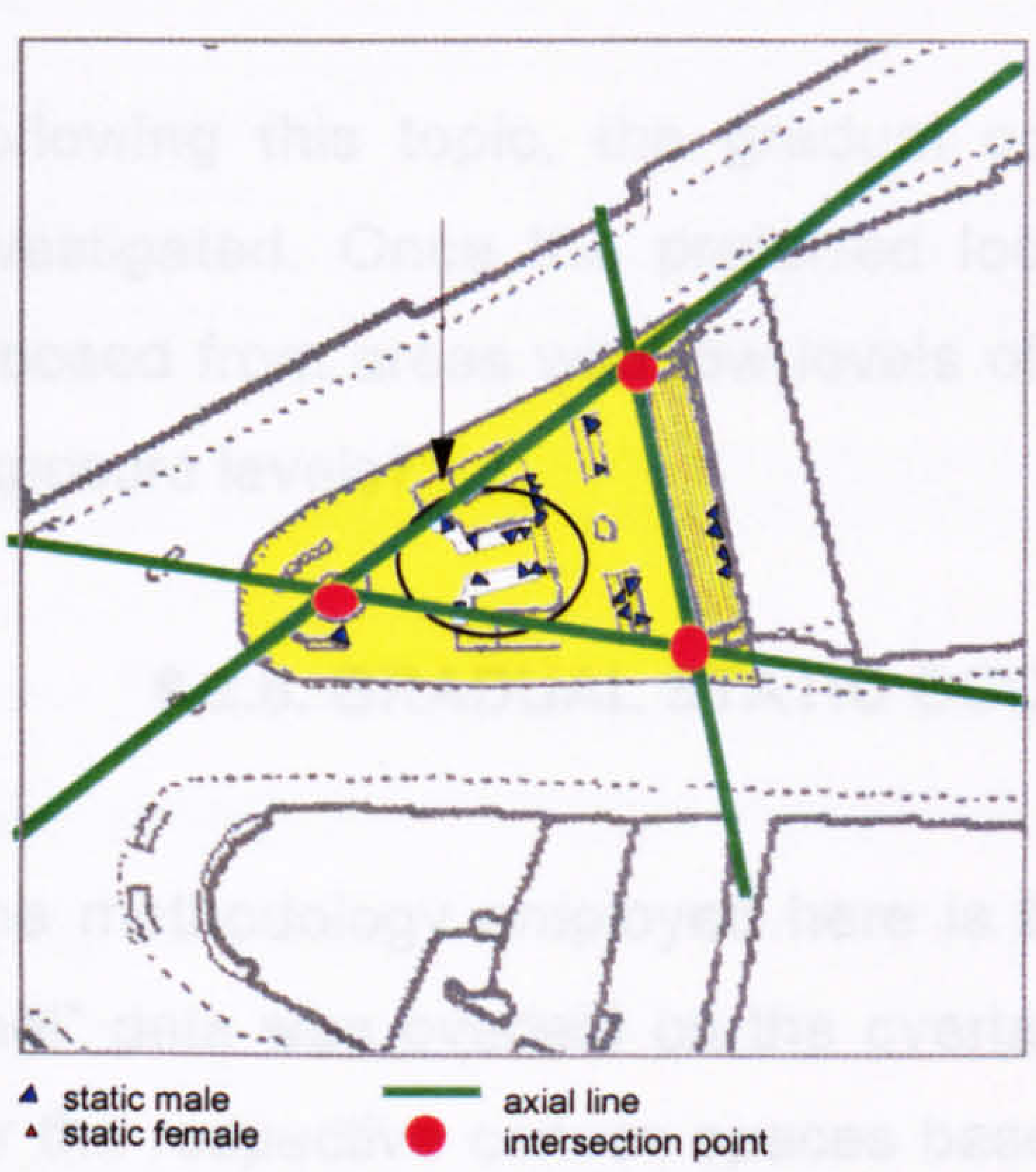

Figure 6.22. Bank Corner static occupancy and interfacing axial lines (scale 1:1500)

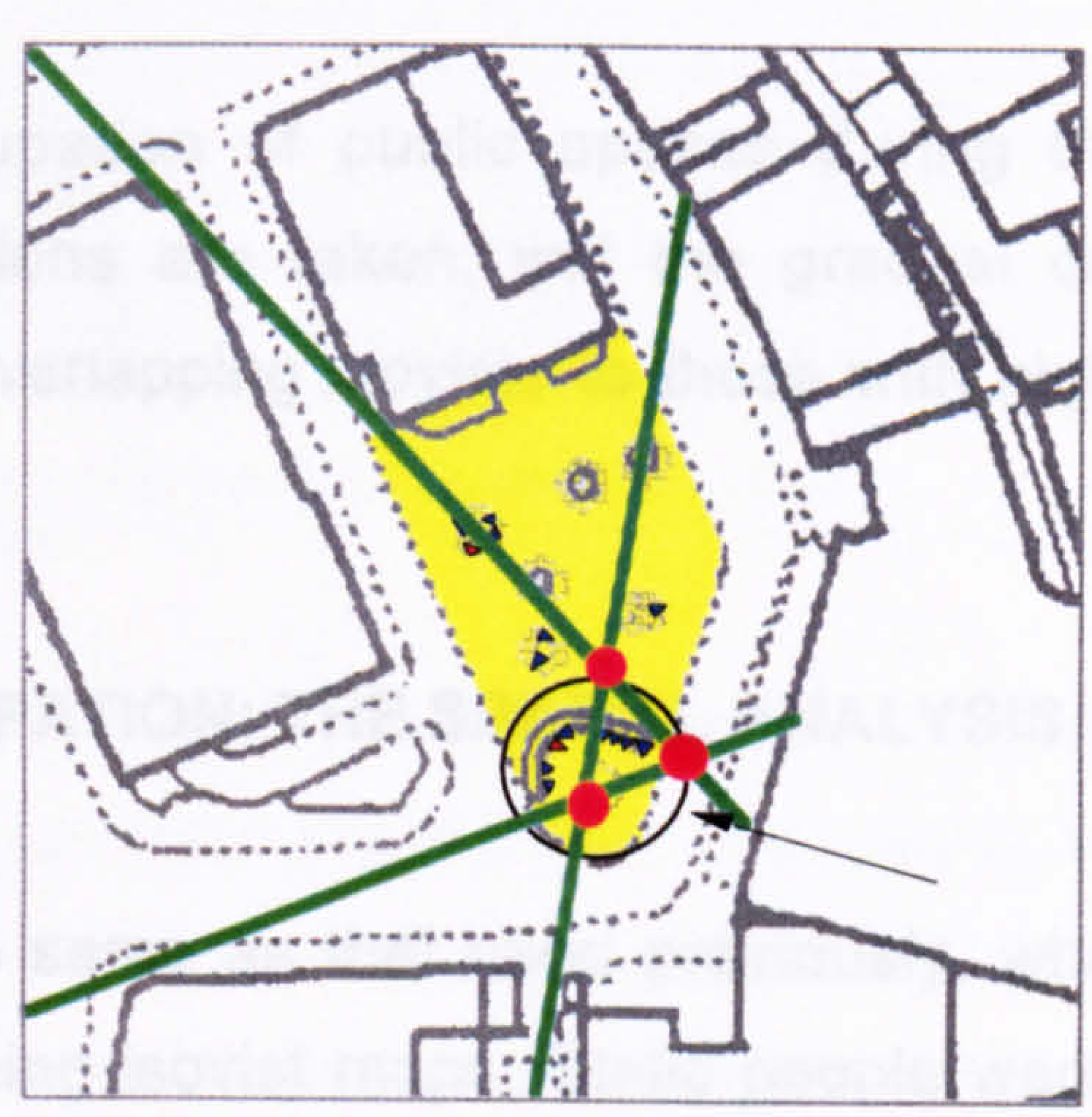

Figure 6.23. Fenchurch Place static occupancy and interfacing axial lines (scale 1:1500)

Whyte (1980) also mentions that the majority of people select their site for occasional encounters right or very close to the pedestrian traffic lines intersecting the public spaces. However an important distinction must be made here. Whyte's findings are associated with casual encounters, people meeting in transit between destinations. This is a very different situation to static occupation for a certain length of time.

Contrary to current ideas concerning the preferred locations for static activities, this research suggests that people do not necessarily sit where the main pedestrian flow occurs. Static occupation is truly a local spatial property, which is inversely related to the increasing degree of visual connections between public spaces and the surrounding urban environment. The fact that the activities of static people do not restrict themselves to particular locations reinforces the suggestion that the choice of a place to stop is a function of the spatial configuration of public spaces in relation to the urban fabric. People have a tendency to look for more secluded areas rather than very exposed ones, regardless of the activity involved.

It is also suggested that a more sophisticated pattern in selecting good locations for static behaviour exists. After having arrived at public spaces through the linear properties of space, users may at this point choose locations that provide them with a reasonable degree of privacy. Total exposure, the concern of the public gaze[37], is something undesirable. The first area of the public space seen when approaching by the user while moving around in the urban environment is the one to be avoided and a more secluded location is selected, preferable nearby. Hence, the user is in control of how far s/he wants to be visually exposed but without losing the ability to see.

Following this topic, the gradual occupation of public spaces during the day is investigated. Once the preferred locations are taken, will the gradual occupation proceed from areas with low levels of overlapping isovists to those with high visibility exposure levels?

6.2.5. GRADUAL STATIC OCCUPATION: THE SPATIAL ANALYSIS

The methodology employed here is the same as that used previously, where "snap shot" data was overlaid on the overlapping isovist maps. Static people were counted for the respective convex spaces based on the three levels of exposure: low, medium

[37] From Valentine, 1998.

and high. The categories of suits at pubs and office smokers were omitted as before and no distinction was made according to activities. Table 6.9 shows the results individually for the twelve public spaces and Table 6.10 summarises the results of the total sample.

Time / level	Abch yard	Bank Corn	Exch. Sq.	Fenc Place	Finsb Av.	Fleet Place	Love Lane	New Chan	Nort Guild	Roya Exch.	St. Anne	Whitt Gds.
8:40 am												
Low	2.00	4.50	5.50	0.50	1.00	0.50	1.00	0.00	0.50	4.50	3.00	0.00
Medium	0.50	1.00	0.00	1.00	1.00	0.00	0.50	0.00	0.00	0.00	0.00	6.00
high	0.00	0.50	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	2.50	6.00	5.50	2.00	2.00	0.50	1.50	0.00	0.50	4.50	3.00	6.00
10:40 am												
Low	2.00	10.00	15.50	3.00	1.50	0.50	2.00	0.00	2.50	10.00	2.50	2.00
Medium	1.00	7.00	3.50	6.50	5.50	2.50	1.00	0.00	1.00	6.50	1.00	3.50
high	0.00	1.50	0.00	3.00	2.50	0.00	3.50	0.00	0.00	1.50	0.50	2.50
Total	3.00	18.50	19.00	12.50	9.50	3.00	6.50	0.00	3.50	18.00	4.00	8.00
12:10 pm												
Low	6.00	12.50	38.00	4.00	4.00	0.00	2.00	3.00	2.00	12.50	2.50	4.50
Medium	1.00	13.00	3.50	2.50	13.50	3.00	1.00	1.50	0.00	5.50	3.50	6.50
high	0.50	7.00	0.00	4.50	2.00	1.00	4.50	1.00	0.00	4.50	1.50	1.00
Total	7.50	32.50	41.50	11.00	19.50	4.00	7.50	5.50	2.00	22.50	7.50	12.00
12:40 pm												
Low	12.50	55.00	108.5	13.50	9.50	9.50	7.50	5.00	14.00	23.50	4.00	6.00
Medium	1.00	24.50	5.50	8.00	35.00	1.00	23.50	3.00	10.00	3.50	14.00	12.50
high	0.00	6.50	0.00	6.00	6.50	1.50	11.50	0.00	0.00	5.00	2.00	3.00
Total	13.50	86.00	114.0	27.50	51.00	12.00	42.50	8.00	24.00	32.00	20.00	21.50
13:10 pm												
Low	8.00	65.50	199.0	12.00	24.50	10.50	16.50	5.50	24.50	36.00	7.50	10.00
Medium	2.00	24.00	22.00	13.50	45.50	5.50	44.50	5.50	11.50	4.50	21.50	10.50
high	0.00	7.00	0.00	17.00	9.50	2.50	19.00	3.50	3.00	13.00	2.00	3.00
Total	10.00	96.50	221.0	42.50	79.50	18.50	80.00	14.50	39.00	53.50	31.00	23.50

Table 6.9. Mean number of static people (over two days) for each public space according to coverage density levels, areas and time of day

Level: mean number	8:40 am	10:40 am	12:10 pm	2:40 pm	13:10 pm
Low	1.917	4.292	7.583	22.375	34.958
Medium	0.833	3.250	4.542	11.792	17.542
high	0.083	1.250	2.292	3.500	6.625
Total	2.833	8.792	14.417	37.667	59.125

Level: percentage[38]	8:40 am	10:40 am	12:10 pm	2:40 pm	13:10 pm
Low	72.42%	48.82%	47.88%	54.87%	50.76%
Medium	24.55%	36.96%	32.88%	35.03%	34.92%
high	3.03%	14.22%	19.24%	10.10%	14.32%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

Table 6.10. Mean number of static people and percentages (over two days) for the twelve cases according to coverage density levels, areas and time of day

From Table 6.10 above, it is clear that, although there is an increase in the number of static people in areas with high levels of coverage density over time (which in principle would be the last areas to be occupied) there is also a steady increase for the other two levels of coverage density. If we look at the percentages of static occupancy for

[38] The percentages were calculated by firstly working out the percentages for each public space and the mean for all cases was calculated at the end.

the different times (Table 6.10), we can see that saturation does not occur for areas with low coverage density (which are the preferred location for static occupancy) with a gradual increase for the remaining two. This is better illustrated in Figure 6.24. The results (the percentage of the mean number of static occupancy, from Table 6.10, is printed at the top of the histogram bars) show that for the three lunchtime periods (12:10 pm, 12:40 pm and 1:10 pm), once more the preferred location for static occupancy is inversely related to the levels of coverage density.

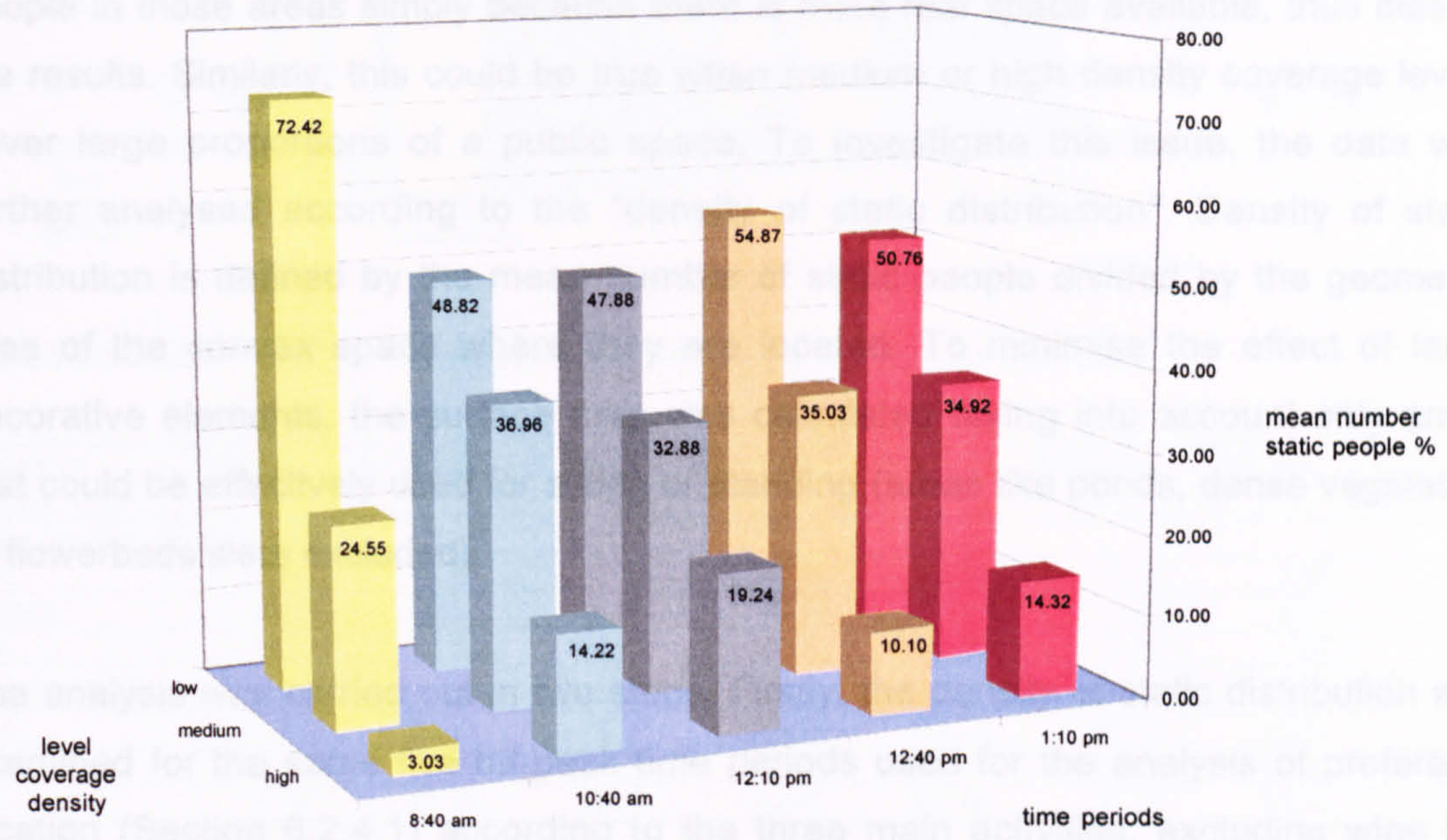

Figure 6.24. Spatial distribution of static people according to time periods and levels of coverage density

Regarding to the gradual occupation, public spaces are not restricted public areas, where only limited numbers can be accommodated. Generally speaking, there is always room to accommodate more people. For all the public spaces of the sample, although varying substantially in size, there was never a situation (even in the peak lunchtime period) where all the available space was fully occupied by users. If there were no formal places left to sit, people tended to accommodate themselves around flowerbeds or on any available seating area. Whyte (1988) in his study of small urban spaces in New York suggests that there is a spontaneous self-levelling regarding the carrying capacity of public spaces. People naturally avoid areas in case of becoming too overcrowded.

6.2.6. THE EFFECT OF GEOMETRIC AREA ON THE STATIC DISTRIBUTION AND COVERAGE DENSITY LEVELS

As discussed previously, levels of static occupancy is strongly associated to public spaces strategic value and not their geometric area. Converting the static occupancy to density will not give a true indication of performance of public spaces. Yet, it is possible in some cases that low coverage density areas actually cover a significant amount of the public space surface area. Therefore, there is a possibility that there will be more people in those areas simply because there is more real space available, thus biasing the results. Similarly, this could be true when medium or high density coverage levels cover large proportions of a public space. To investigate this issue, the data was further analysed according to the "density of static distribution". Density of static distribution is defined by the mean number of static people divided by the geometric area of the convex space where they are located. To minimise the effect of large decorative elements, the surface area was calculated taking into account only areas that could be effectively used for sitting or standing (areas like ponds, dense vegetation or flowerbeds were excluded).

The analysis was carried out in two steps. Firstly, the density of static distribution was examined for the same five off-peak time periods used for the analysis of preferable location (Section 6.2.4.1) according to the three main activities, excluding wine bar users and office smokers. Table 6.11 summarises the findings, where it compares the results for the mean number of people (as showed in Table 6.6) and density of static distribution according to coverage density levels. A graphic representation of these results is illustrated in Figure 6.25, where the density of static distribution has been converted to a percentage of the total number in each category (low, medium or high levels of coverage density) and the results are printed at the top of histogram bars. Secondly, the analysis was carried out by assessing all eight time periods individually, but without differentiating between different activities. The data is presented in Table 6.12, further illustrated according to percentages in Figure 6.26.

	Total (3 activities)			Eating and drinking			Relaxing			Reading		
Coverage density level	low	med	high	low	med	high	low	med	high	low	med	high
Mean nº people	3.15	2.22	0.72	0.69	0.51	0.05	2.01	1.40	0.56	0.45	0.31	0.11
Density of static distribution (10^{-5}people/m^2)	40.2	34.6	27.8	8.79	8.01	1.83	25.6	22.1	21.5	5.77	4.80	4.36

Table 6.11. Mean number and density static distribution according to activities and levels of coverage density

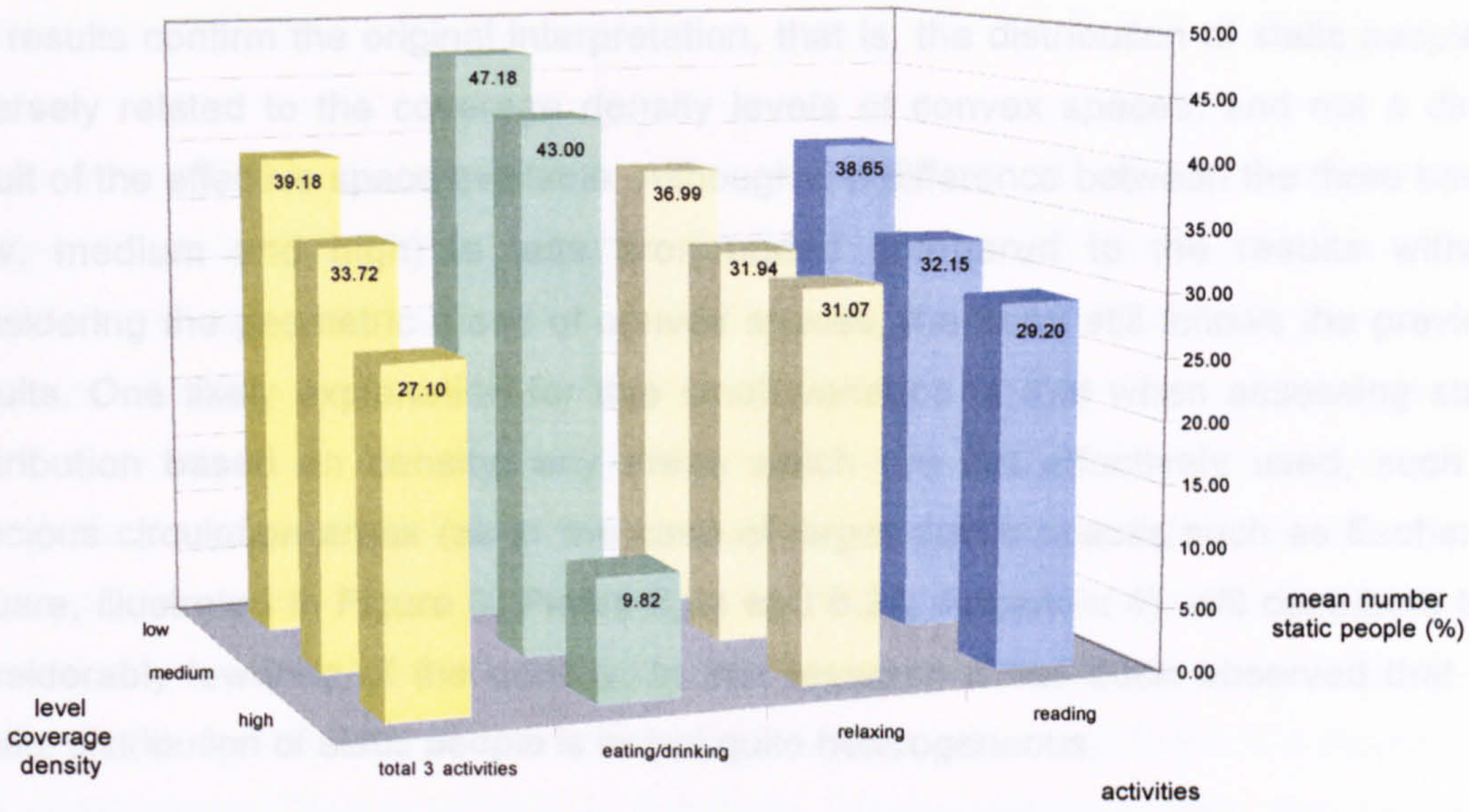

Figure 6.25. Density of static distribution according to activities and levels of coverage density

Coverage density level	8:40 am	10:40 am	12:10 pm	12:40 pm	13:10 pm	3:40 pm	4:40 pm	5:40 pm
Mean number of static people								
Low	1.92	4.29	7.58	22.38	34.96	3.79	3.04	1.58
medium	0.83	3.25	4.54	11.79	17.54	2.79	2.38	1.21
high	0.08	1.25	2.29	3.50	6.63	0.79	0.67	0.46
Density of static distribution – results in 10^{-5}people/m^2								
Low	24.35	54.53	96.36	284.31	444.20	48.18	38.65	35.66
medium	12.97	50.57	70.67	183.49	272.97	43.44	36.96	33.33
high	3.18	47.73	87.50	133.64	252.96	30.23	25.46	31.02

Table 6.12. Mean number and density static distribution according time periods and levels of coverage density

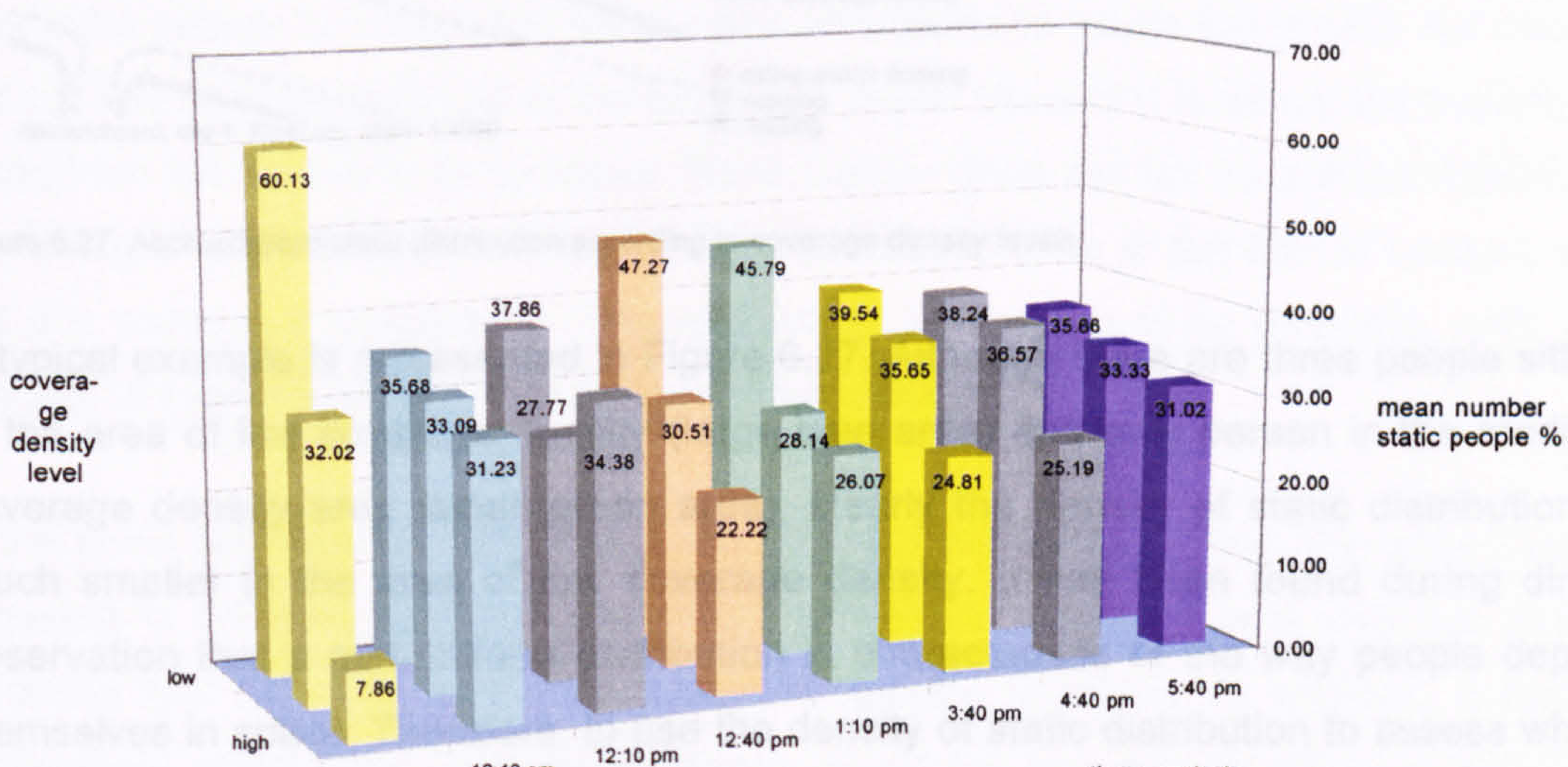

Figure 6.26. Density of static distribution according to time periods and levels of coverage density

As illustrated in Figures 6.25 and 6.26 (with the exception of the 12:10 am time period) the results confirm the original interpretation, that is, the distribution of static people is inversely related to the coverage density levels of convex spaces, and not a direct result of the effective space available. Although the difference between the three bands (low, medium and high) is less pronounced compared to the results without considering the geometric areas of convex spaces, the trend still follows the previous results. One likely explanation for this small variation is that when assessing static distribution based on density, any areas which are not effectively used, such as spacious circulation areas (as in the case of larger public spaces such as Exchange Square, illustrated in Figure 3, Plates 6.24 and 6.25, Appendix 4), will contribute to a considerably lowering of the density. In this research it has been observed that the spatial distribution of static people is in fact quite heterogeneous.

Figure 6.27. Abchurchyard static distribution according to coverage density levels

A typical example is represented in Figure 6.27. Although there are three people sitting in the area of low coverage density (large blue area) and only person in the medium coverage density area (small green area), clearly the density of static distribution is much smaller in the area of low coverage density. It has been found during direct observation that a non-uniform distribution is characteristic of the way people deploy themselves in space. Therefore, to use the density of static distribution to assess which areas are preferred by the public, this method will not reflect the true spatial distribution. If we were to discount all areas that were not being used, we would end up, in practical terms, using the methodology which was applied in the first place, that is, using the mean number of static distribution rather than the density. Therefore, the results of the analysis suggest the postulation that the area is not a significant consideration for static distribution.

Previous research has shown similar trends for the distribution of people inside public spaces. Whyte (1980) noticed that although the number of people inside public spaces varies considerably from place to place, "The way people distribute themselves over the space, however, will be fairly consistent, with some sectors getting heavy use day in and day out, others much less" (Whyte, op.cit., p18). Whyte also discusses what he calls "effective capacity". From his observations, he concluded that people do not distribute themselves evenly across the public space. People tend to avoid empty areas and "join" other people, suggesting that people have a tendency to cluster (Whyte, op.cit. p167). However, in this case, it is suggested that there is a reason why and where people tend to cluster. In the public spaces observed here, people cluster because they invariably prefer to be in the same specific areas. There is a clear logic where people consistently look for areas which are visibly less exposed from the outside, although with generous isovists from within.

From this description, both Gehl's idea that the edges of a public space is crucial to determining the pattern of static occupancy and Alexander's assertion that "If the edge fails, then the space never becomes alive" (Alexander, 1977, p600), meaning that the space will become a place to walk through and not a place to stop, seem to be secondary. The edge effect exists, as we can see in the case of Fenchurch Place, where the pattern of occupation does follow an outside-to-inside movement, but people will not feel constrained to sit at the edge of a public space if it is where the majority of pedestrian movement is to be found. Bank Corner does not fail as a public space, in fact it might be considered one of the most successful ones in the City of London, and yet the pattern of occupation follows a clear inside-to-outside direction, with the majority of people sitting away from the main pedestrian flow.

In the same way as there are people relaxing in public spaces, there are other people engaged in different activities. As previous findings suggest; there was not strong evidence that different activities will require specific locations. In addition, activities themselves might vary. The same person could be engaged in different activities during the time he spends in the public space. It is not unusual for someone first to eat something and after to read a newspaper, for instance.

To summarise, it is suggested that the preferred location for static occupancy is inversely related to the convex space degree of visibility exposure, and this was shown to be consistent throughout the day, for all time periods. In addition, it is suggested that a second underlying principle exits where users prioritise locations close to high coverage density. However, there was never a situation where the areas with low levels of overlapping isovists were completely taken up by static activity, thus forcing the users to occupy other areas and establishing a profile as suggested by the previous authors who have claimed that the occupation follows an outside-to-inside movement, for instance. It seems that if this phenomenon is to be found in a particular public space, and there does seem to be a small minority of users who do prefer to sit in visually well connected areas, those individuals will sit in prominent positions throughout the day. Therefore, the pattern of occupation is not sequential but evenly distributed through time, though spatially uneven distributed.

6.3. INTERVIEW WITH THE USERS

A survey was undertaken to further understand why people would use certain locations. Users of the public spaces were interviewed during late summer 1996[39]. At least ten people were interviewed for each public space, totalling 127 interviews. From those 127, 45% were female and 55% were male. Because the interviews were carried out during the lunchtime period, 73% of all interviewees were eating and/or drinking. This was followed by 14% in the reading category and 13% in the relaxing category (Table 6.13 in Appendix 4 gives the replies for all users). Apart from collecting data on gender and type of activities, the interviewees were asked three questions:

- Where do you come from (how far do you travel to be here at lunchtime)?
- How often do you come here (when the weather is fine)?
- Why did you come here (today)?

Regarding question 1, the interviewees were given a copy of a map of the City of London and they were asked to point out were they came from as illustrated in Figure 6.28, next page.

[39] The interviews were carried out between 13th September and 1st October, 1996.

Figure 6.28. City of London map and interviews replies

not to scale
illustration only

Figure 6.29 illustrates the replies on distance travelled. The mean distance from each public space is at the top of each respective column with the mean travel distance for the whole sample on the right-hand side of the diagram.

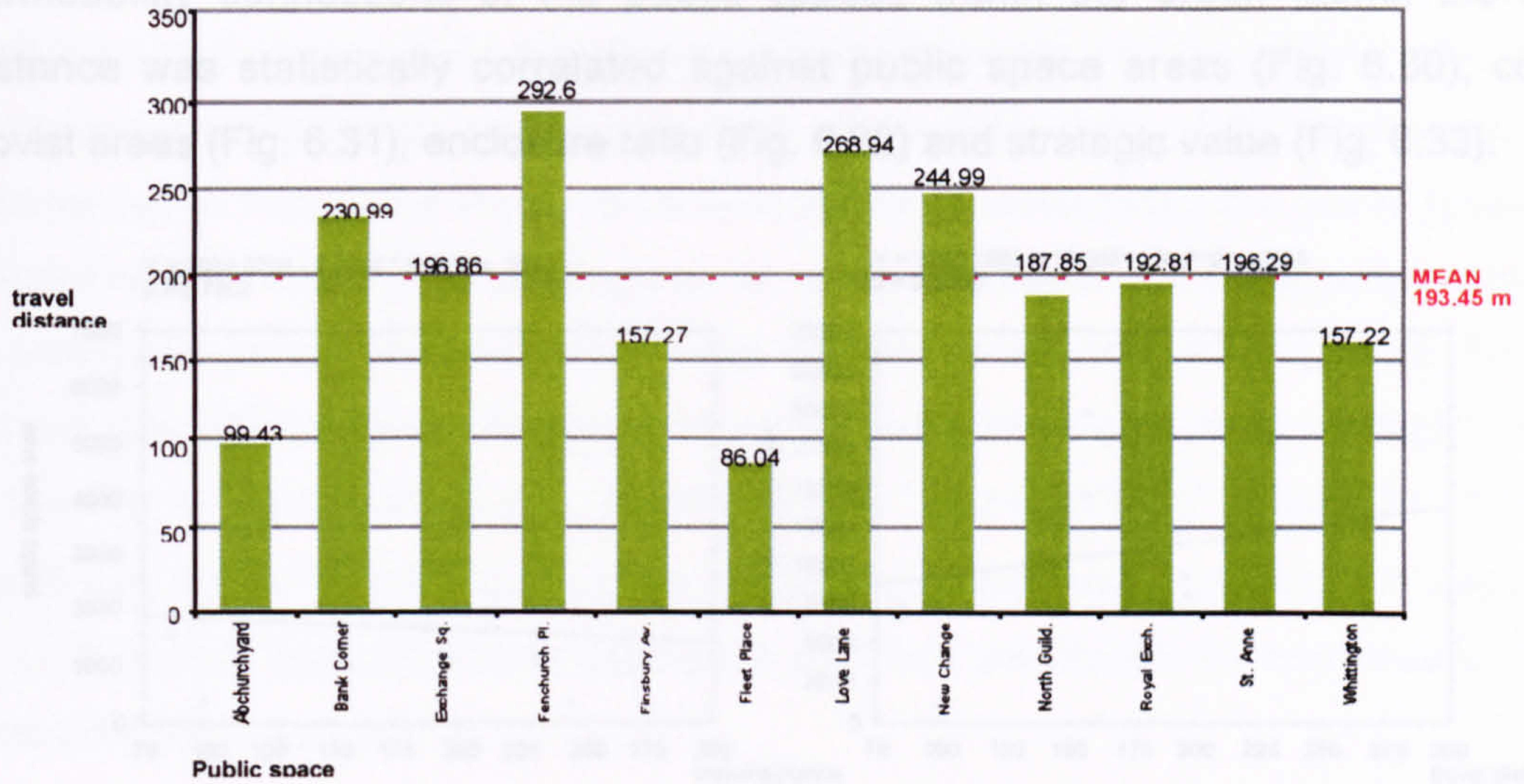

Figure 6.29. Mean travel distances (m) between users' origin and respective public spaces as destinations

A similar study was carried out previously by the London County Council (1968). More than 30 years ago, the study showed that, on average, users would frequent the public spaces about once a week and most of them would live nearby. The study also concluded that the bigger the open areas, the greater the travel distance was likely to be[40].

There is a group of four public spaces, Exchange Square, North Guildhall, Royal Exchange and St. Anne & St. Agnes churchyard, that vary considerably in size but have similar mean travel distances. Finsbury Av. and Whittington Gardens, with almost identical mean travel distances, are close to the previous group. There is one remaining group (Bank Corner, Fenchurch Place, Love Lane Corner and New Change) where the travel distances are substantially higher than the average for the sample, although this is not statistically significant as revealed by t-tests[41]. Conversely, the two remaining cases, Abchurchyard and Fleet Place, are the two public spaces where the

40 Information extracted from Llewelyn-Davis Planning, 1992.

41 The results of the t-tests are Bank Corner: $t = 0.846$ for $p = 0.4156$, Fenchurch: $t = 1.603$ for $p = 0.1434$, Love lane Corner: $t = 0.99$ for $p = 0.3483$ and New Change/Cheapside Corner: $t = 0.607$ for $p = 0.5577$.

mean distance travelled is statically smaller than the mean for the sample[42].

To investigate whether the users distance travelled is a function of the visual and permeability connections of the public spaces within the urban fabric, the travel distance was statistically correlated against public space areas (Fig. 6.30), convex isovist areas (Fig. 6.31), enclosure ratio (Fig. 6.32) and strategic value (Fig. 6.33).

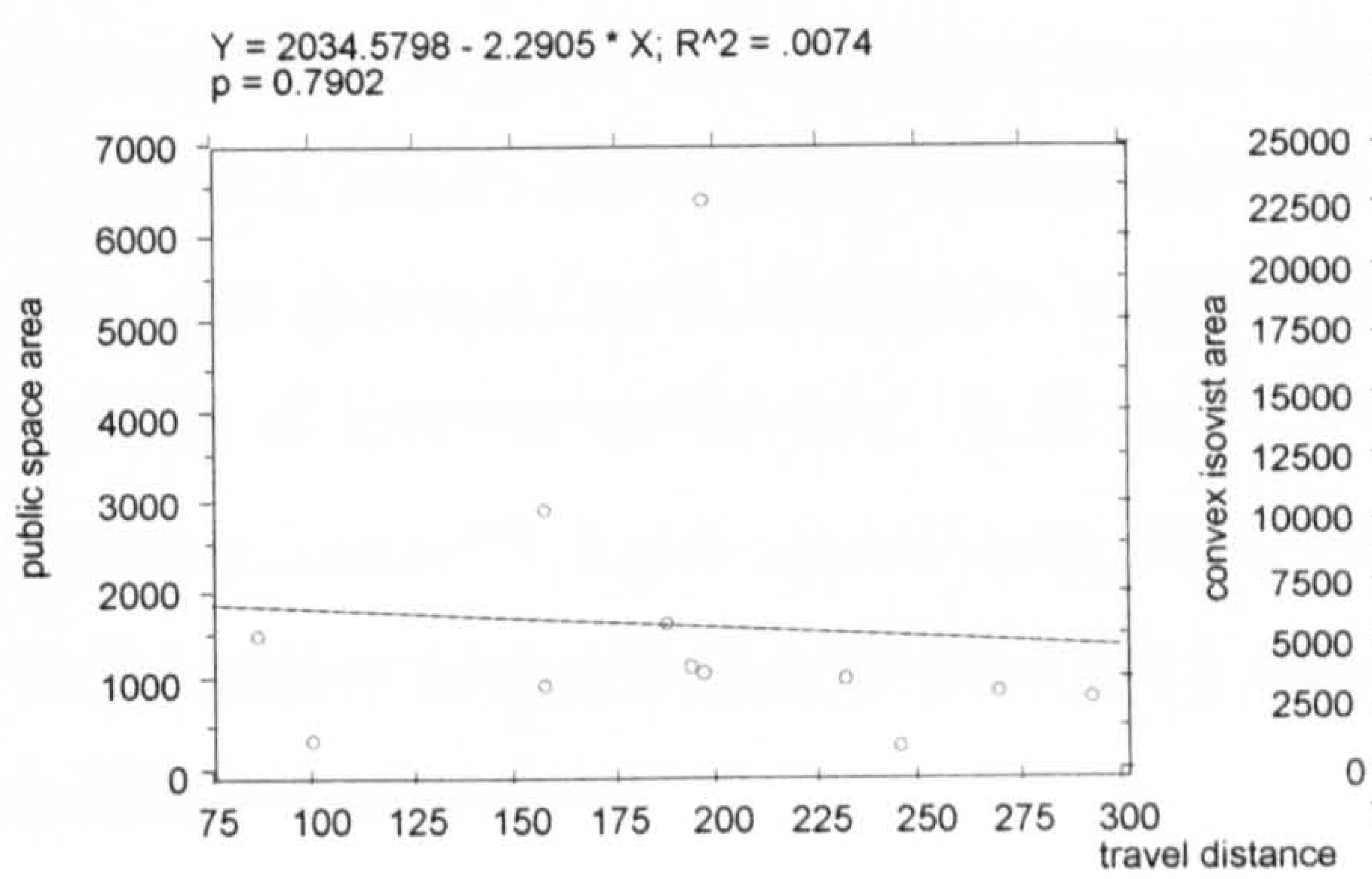

Figure 6.30. Scattergram for the mean travel distance and metric area of public spaces

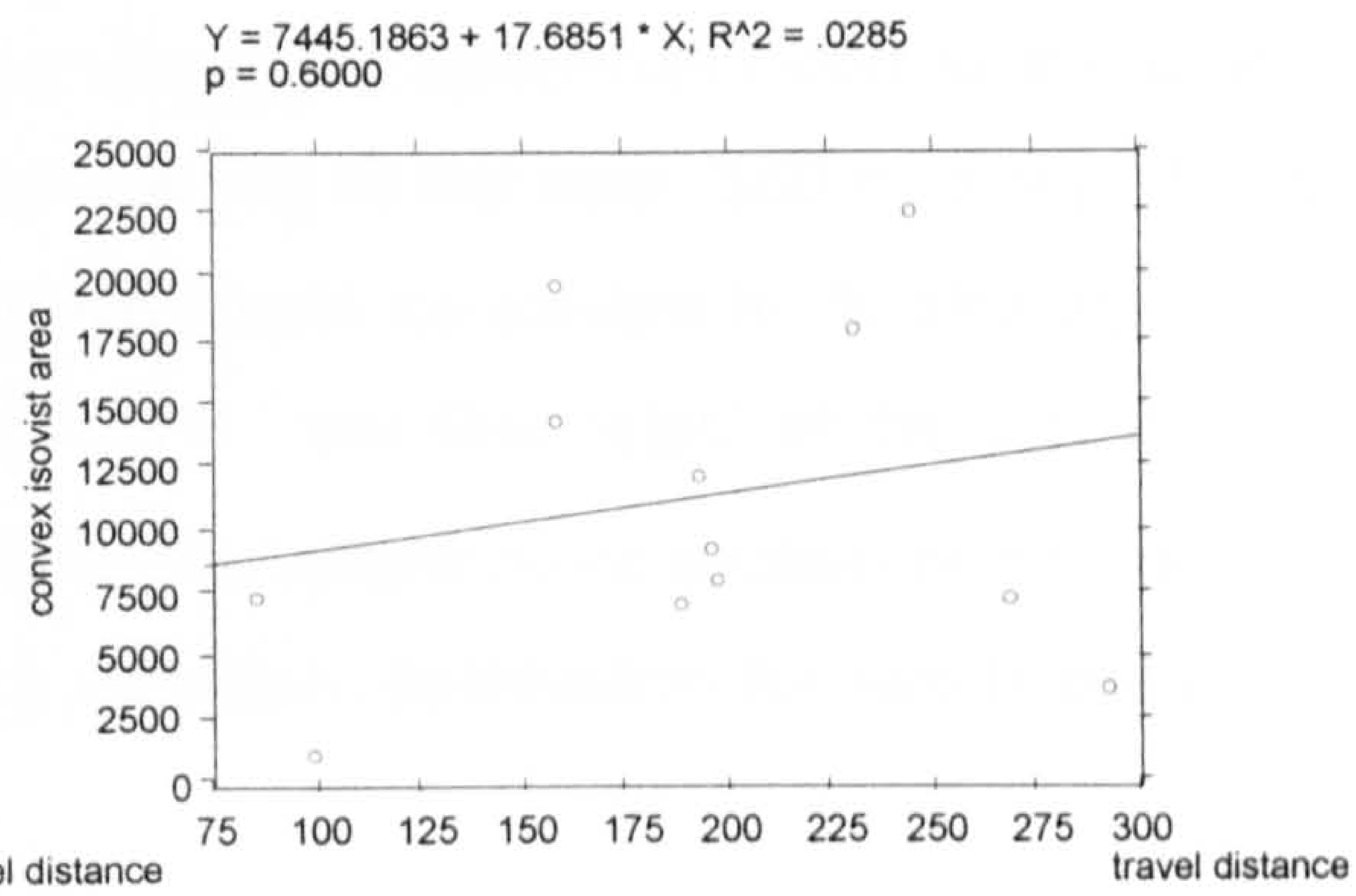

Figure 6.31. Scattergram for the mean travel distance and isovist area of public spaces

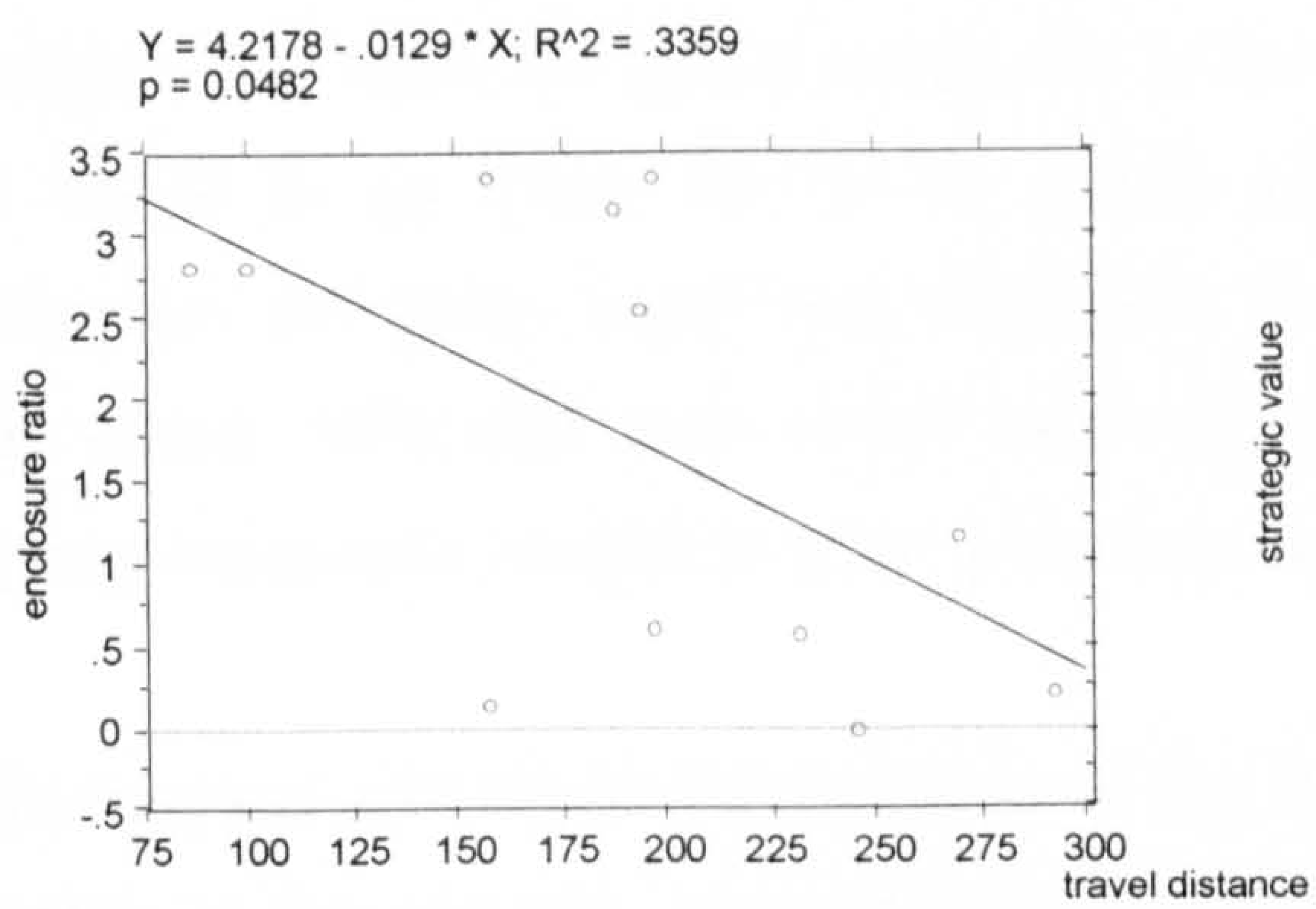

Figure 6.32. Scattergram for the mean travel distance and enclosure ratio of public spaces

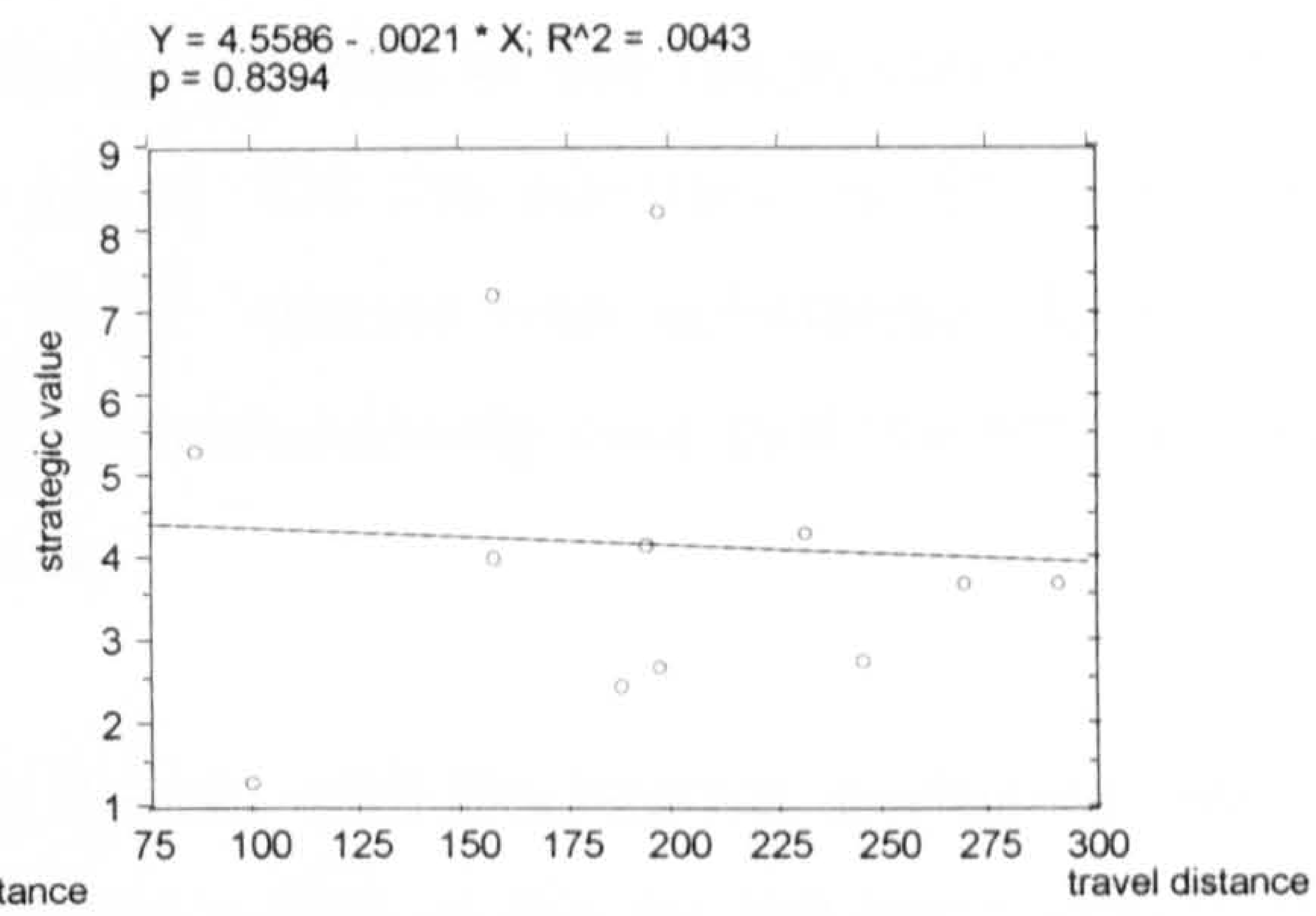

Figure 6.33. Scattergram for the mean travel distance and strategic value of public spaces

As we can see from the scattergrams (Figs. 6.30 to 6.33), there is no correlation between any of the above mentioned variables and travel distance. In fact, even for the enclosure ratio variable, although in principle the results indicate a negative linear correlation[43], the scattergram shows two groups of six public spaces with similar enclosure ratios but variable distance travels. Concerning the group of four public

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[42] The results of the t-tests are: Abchurchyard: t = - 4.748 for p= 0.001 and Fleet Place: t = - 6.72 for p = 0.0001.

[43] The results for Kendall Rank Correlation for travel distance and enclosure ratio revealed no association between the two variables: Tau corrected for ties = - 0.3333 for p = 0.1314.

spaces to which users travel from longer distances (Fig. 6.29), it is suggested that this might be related to singular factors which can enhance their appeal.

Both Bank Corner and Fenchurch Place are physically associated with underground and train station access and therefore a higher number of City workers who do not necessarily work nearby get to know the place. Only 20% of all people who were interviewed in Fenchurch Place came from buildings surrounding the public space. The remaining 80% came from buildings as far away as Leadenhall Court to the west (350 m away) or London Commodity Exchange Building to the east (550 m away). For Bank Corner, the greater travel distances recorded might be related to its strategic location in the City of London urban grid, in terms of the " two-step logic" of the City which was mentioned earlier[44]. Bank Corner was the public space most spoken of an "easy place to find", mainly because it was used as a common destination for two friends coming from different directions.

In the case of New Change/Cheapside Corner it might be that this is the only public space in the area that has a wine bar. Love Lane Corner might appeal to people who are especially keen on green areas. In Love Lane, 30% of the respondents said that they chose to go there due to its green areas. On the contrary, in St. Anne and Whittington Gardens, which are the other public spaces with substantial designated green areas, 10% and none of the respondents respectively said that the main reason for going there was related to their green areas.

Abchurchyard and Fleet Place are both the spaces with the highest enclosure ratio of all cases in the sample, represented by the two points at the far left-hand side in the scattergram, Figure 6.31. Abchurchyard is the space that recorded the smallest number of static people, as it has only one axial line with medium local and global levels of integration, therefore characterising it as a very localised space. Fleet Place, although with a significant strategic value compared to the other cases of the sample, is in fact the only case that under-performs in relation to its static occupancy. 80% of all the people who were interviewed came from the buildings surrounding the public space. The remaining 20%, from buildings from the other side of Holborn viaduct, around 150 m away. One possible explanation for the lower than expected number of static people might be the fact that when the data was collected, some of the surrounding buildings were still not completely occupied. But definitely, more research

[44] Refer to Section 5.1.4, Chapter 5.

has to be done specifically about the relationship between the users of individual public spaces and their travel distances[45].

As far as the frequency of visits is concerned, the mean frequency distribution for the sample revealed that 21% said that they use the public spaces every day in good weather. Table 6.14 illustrates the results.

Frequency	Count	Percentage
Every day	27	21.26
4 times a week	11	6.67
3 times a week	15	11.81
Twice a week	15	11.81
Once a week	16	12.59
Once a fortnight	2	1.58
Once a month	15	11.81
Occasionally	12	9.45
First time	14	11.02
total	127	100.00

Table 6.14. Frequency of visits

When the public spaces were analysed individually, it was expected the public spaces which are visited by City workers who are placed nearby, as in the case of Fleet Place, would be the ones to be visited by the same people more often. In Fleet Place, 50% of respondents said that they came to the public space every day. Conversely, for Fenchurch Place and New Change/Cheapside Corner which are the public spaces with the highest means for distance travelled, 30% and 36% of users replied that they were there for the first time, the highest number of replies for this category for all cases.

In order to analyse whether there are correlations between the frequency of visits to the public space and other spatial and syntactic measures, the visiting frequencies were ranked (every day scores 9 points, 4 times a week scored 8 points and so on, until first time with one point) and then summed up for all public spaces. Surprisingly, no correlation was found between frequency of visits and travel distances (Fig. 6.34) and between frequency visits and strategic value (Fig. 6.35).

[45] The travel distances variable was also correlated against sum of isovist lengths, mean number of static people and mean number of moving people inside the public space (both from 8 am to 4:40 pm). In all the cases, no linear correlation was found, as follows: Sum isovist total: R-squared = 0.0186 with p = 0.6724; sum isovist selected: R-squared = 0.016 with p = 0.6956; sum isovist special: R-squared = 0.0127 with p = 0.7274; mean number static people: R-squared = 0.0016 with p = 0.9012 and mean number of moving people: R-squared = 0.0001 with p = 0.9736.

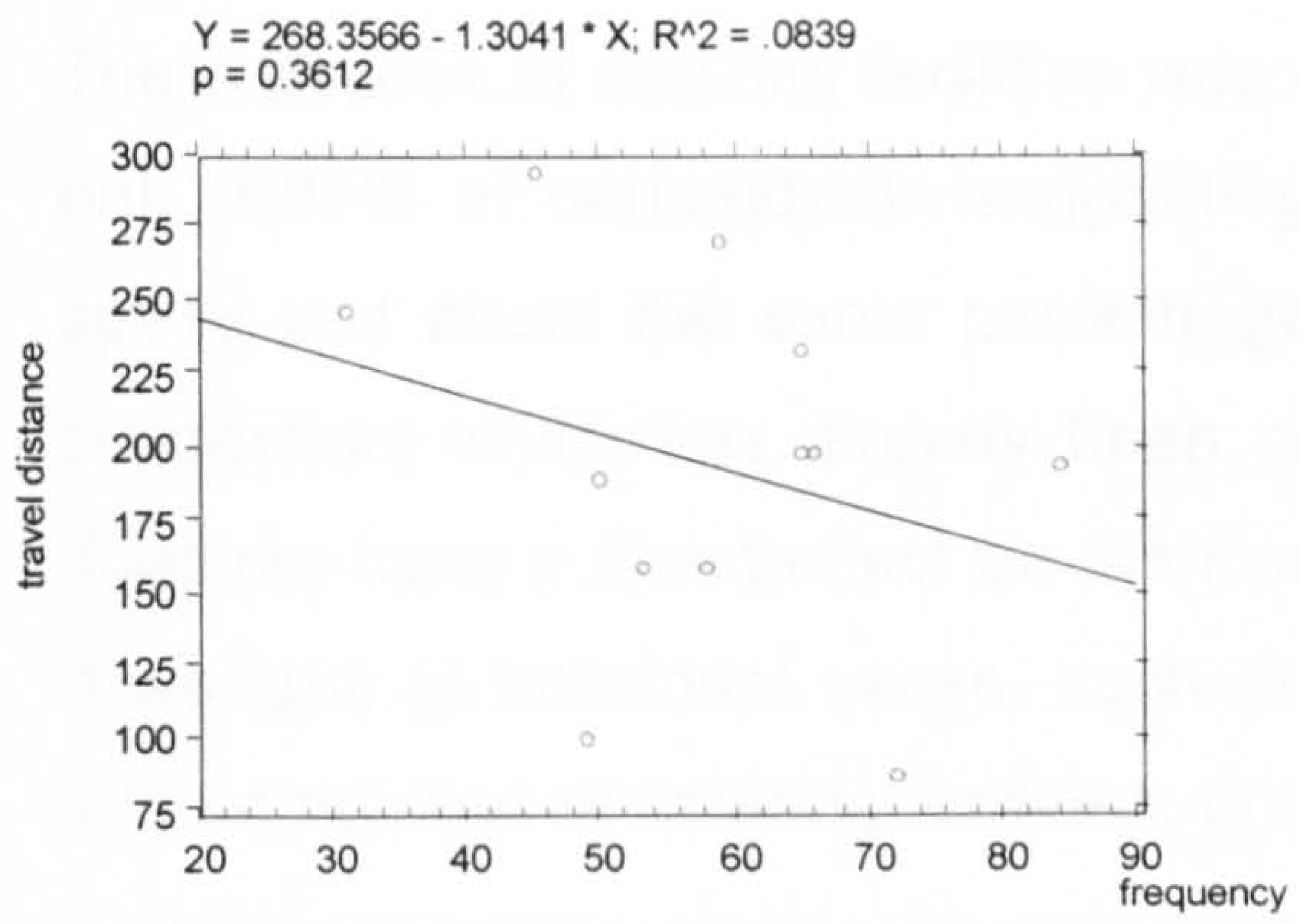

Figure 6.34. Scattergram frequency
and mean travel distance

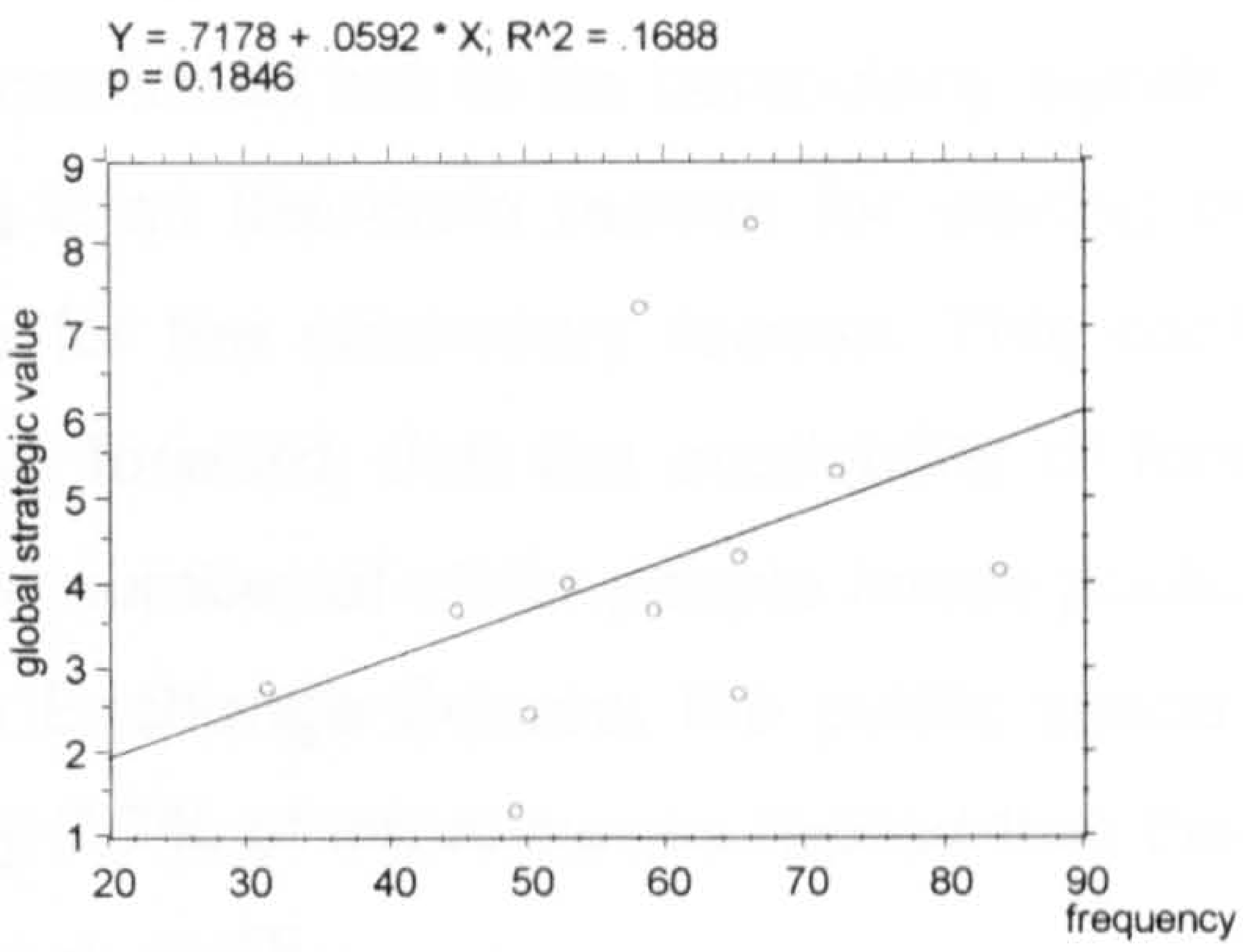

Figure 6.35. Scattergram frequency
and strategic value of public spaces

Lastly, the users were asked what was the main reason for them frequenting that specific public space. No suggestions were given and they were free to say as many reasons as they wanted, as long they were ranked in order of priority. Table 6.15 summarises the results.

Replies	Reason 1		Reason 2		Reason 3	
	Count	Percentage	Count	Percentage	Count	Percentage
Pleasant	4	3.15	2	4.08	1	16.67
Close to work	53	41.73	7	14.29	•	•
Between work places	16	12.60	1	2.04	•	•
Quiet	11	8.66	8	16.33	•	•
Good seats	10	7.87	8	16.33	•	•
Spacious	•	•	1	2.04	1	16.67
Green	3	2.37	3	6.12	1	16.67
Food/drink retails	10	7.87[46]	10	20.41	1	16.67
Others[47]	10	7.87	3	6.12	2	33.32
Far from work	•	•	2	4.08	•	•
Only one around	•	•	1	2.04	•	•
Shops nearby	7	5.51	1	2.04	•	•
Watch events	3	2.37	2	4.08	•	•
total	127	100	49	100	6	100

Table 6.15. Reasons for frequenting the public space

From the survey, it is apparent that being close to work is most important, with 42% of all cases. If we add "between work places" which is a related issue, being associated to work places amounts for 54% of all replies. This confirms the previously reported data on the relatively short distance between work and public spaces covered by most users. Apart from this, all the other replies are almost equally distributed and are very

[46] This includes for all 12 public spaces. If we find the percentage in relation to the eight public spaces with wine bars or pubs, the percentage increases to 10%, but is still well below other replies.

[47] The other category includes: likes the design of the public space, goes to nearby church for recital, position of the sun, the only one s/he knows, you can drink outside, as far as possible from work. Refer to Table 6.13 in Appendix 4.

diverse, ranging from the presence of catering facilities to the availability of good seats. The presence of catering facilities was confirmed not to be particularly significant, with only 7.87% of respondents suggesting it as the main reason for visiting the public space and about the same percentage for the secondary reason. This confirms the suggestion, which has already been put forward, that the availability of food outlets does not have a direct effect on the total number of static people inside public spaces. If we look at individual cases, such as Exchange Square, the public space with the largest number of catering facilities, only 7.7% of interviewees replied that the catering facilities were the main incentive for being there[48].

Summarising, although the questionnaires were not instrumental in collecting information on levels and patterns of static use as the main feature in analysing the success of public spaces, they were very helpful to gain an insight into what might be the reasons for using a public space. Public spaces are used mainly by City workers, whose offices are located nearby, and (providing the weather is fine) they tend to visit the public spaces on a regular basis, and people are willing to travel longer distances if it is worthwhile. The questionnaires have illustrated what makes some public spaces less localised than others. It might be the wine bar, it might be the green aspect, but they are complementary features, most important is their strategic location in relation to the configuration of the urban fabric.

6.4. DISCUSSION AND CONCLUSIONS

The results for the distribution of pedestrian movement and static occupancy help to illustrate once more that to study public spaces independently of the configuration of the urban fabric in which they are embedded is misleading. In these cases, both patterns of pedestrian movement and stationary people are a direct result of the permeability and visibility connections of the public spaces to the urban environment.

Once people arrive at the public spaces through the global properties of the urban fabric, there are two groups that will interact, sharing the same space; those who are moving through the public space and the stationary people who are engaged in some kind of unprogrammed static activity. For moving pedestrians, the complexity of the

[48] Close to work and between working places were the main reason with 77% of all cases. Refer to Table 6.13 in Appendix 4.

internal layout is paramount in so far as it provides the fine tuning for the permeability links and therefore affects decision-making on which route to take between destinations; for static people the internal layout is much less important.

For the distribution of static people, the level of overlapping isovists in the convex space of the public space, is the key issue, rather than where the seats or other decorative elements are placed. In fact, even the internal or external pedestrian routes seem to be secondary when selecting the areas for stationary activities. It is therefore suggested that the distribution of static people is a configurational property rather than a purely spatial one. The key for patterns of pedestrian movement is permeability, whereas for static distribution it is visibility.

Ideally, public spaces should have an even distribution of static people, ie, occupation should not be patchy with some areas being better occupied and others neglected. With a good understanding of the likely areas that will generate stationary activities, public spaces can be better designed, as adequate provision can be made in the appropriate places for seating areas or locations for retailers that enhance the co-presence of stationary and moving people, which can only contribute to the effective use of public spaces.

7

THE NATURE OF PUBLIC SPACES

This thesis has investigated two fundamental issues for the design of public spaces: which spatial properties lead to high levels of static occupation and which spatial properties affect the patterns of static distribution within public spaces.

As discussed in Chapter 1, it has been conjectured that one of the main reasons for the failure of many contemporary examples of public spaces is that planners and designers still perceive public spaces as isolated spatial entities, disregarding their visual and permeability connections to the urban fabric in which they are embedded. In this respect, not only is the configuration of the urban grid, and the associated levels of pedestrian movement, crucial for the levels and the distribution of static people, but also the degree of access between public space and urban fabric. In addition, it has been suggested that some morphological characteristics salient for the good performance of public spaces might also be found in the design of traditional medieval urban squares.

To ascertain the spatial properties implicated in the success of public spaces, twelve public spaces in the City of London were selected. Using a combination of detailed observation and configuration analysis it was possible to analyse the relationship between static behaviour and spatial design.

The main conclusions have been discussed in detail at the end of each chapter. This chapter reviews the main issues, suggesting the link from research to actual design.

7.1. A COMPARISON OF TRADITIONAL AND CONTEMPORARY PUBLIC SPACES

The study of traditional squares in European towns[1] provided some valuable information regarding spatial form and the extent to which urban squares are integrated in the structure of the urban fabric, with the main findings summarised as follows:

1. The mean enclosure ratio was 1.70 varying from 0.34 to 4.02.
2. The area and the sum of the length of isovists are in proportion to the area of the main convex element.
3. The sum of the number, the sum of the length and the sum of the integration values of axial lines that interface (strategic value) with the main convex element are in proportion to its size.
4. The majority (89%) of the axial lines that interface with the main convex element are above the mean integration values of the urban system, and notably 55% belong to the 10% integration core.
5. The majority of axial lines interfacing with the main convex element are convergent (C).

The significance of these characteristics is clear. The morphological study showed that enclosure was indeed a spatial property common to the sample of traditional urban squares, but with strong visual and permeability connections between urban squares and urban environment. The larger the public spaces became in relation to the urban fabric, the larger were the urban squares' visual connections, as a way of being known as part of the urban structure where they were located. The number and integration values of axial lines also give an indication of their strategic location. Based on the theory of natural movement (Hillier et al., 1993a) and the association between the strategic value (Hillier, 1984) and number of static people, the bigger the urban square, the higher the levels of pedestrian movement across the space and consequently the likely higher levels of static occupancy. With the majority of lines interfacing with the urban square part of the integration core (55%) of respective towns, traditional urban squares were as accessible as the most important routes in the large scale structure of the urban grid.

In addition, the results of the classification of axial lines suggest a prioritisation for static occupancy. Convergent axial lines, associated with "to-movement", are present in 90%

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[1] The discussion is based on the results for the whole sample (30 cases). Refer to Chapter 3.

of urban squares and correspond to almost 65.4% of all lines, while transverse axial lines are the least common[2]. This means that pedestrian movement across urban squares is mainly restricted to the periphery (peripheric axial lines) and only occasionally does "through-movement" cross urban squares in central areas. There may be an underlining social logic. As urban squares are essentially a place of destination, ie, of static use (therefore the high number of C lines), any through movement (Transverse (T) and Peripheric (P) axial lines) could have been "organised" as far as possible to occur at the periphery of the urban square so as not to interfere with the static occupancy. This would suggest that the focus of traditional urban squares was for termination rather than continuity as far as levels of pedestrian movement are concerned.

The significance of these results is important for understanding the functioning of mediaeval urban squares. If traditional squares were to be the focus of community life, was an essential property for their functionality being "integrated" spatial elements, as to be used for static activities. This is supported by previous studies by Girourard (1985) and French (1978) suggesting that traditional urban squares were the focus of everyday transactions and encounters, of monetary trade but that they also had social, political and religious functions. Morris (1994) states: "All medieval towns contained a space, if not several, which acted as a market...Trade and production went on in all parts of the city; in open spaces and in closed spaces; public spaces and private spaces" (Morris, op.cit., 99). Benevolo (1980), although looking at the development of the urban environment from an historical point of view, suggests that in medieval towns, public squares were not just self-contained open spaces but were closely integrated with streets running into them. Benevolo adds that with the exception of some thoroughfares, streets and squares "were designed to be used as places to stop, to conduct business or for holding meetings" (Benevolo, op.cit., p308). Although this type of information was not available for the urban squares of the sample, it is assumed that they were also an important part of their community life.

From the comparative analysis between the two convex representations (main convex element for traditional urban squares and the convex container for public spaces in the City of London), all the properties found in the sample of traditional squares were subsequently identified for the sample of contemporary public spaces in the City of London[3]. The larger the convex container, the stronger the visual and permeability links

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[2] They correspond to 8.8% of all lines and are found in 12 out of 30 traditional urban squares.

[3] There is only one exception. A positive linear correlation was found between the area of the convex element and the mean length of axial lines for the traditional urban squares sample and not for the contemporary ones. Refer to Table 4.15 in Chapter 4.

to the urban environment as described previously. Also, for the convex container representation, there is a predominance of C, followed by P and then T axial lines with a mean enclosure ratio of 2.05.

However, the convex container was used as a comparative device between the two samples. Although the lack of information from the original maps was the main reason for adopting the convex representation for traditional squares, this representation probably is very close to reality in terms of the effective space used for static activities. Therefore, by comparing the results for the convex representation (traditional urban squares) to the effective space (contemporary public spaces) we can examine the differences and similarities between the two samples and the relevance for the level and distribution of static people.

For the public spaces in the City of London4 and the traditional urban squares, the analysis showed that there are three common sets of properties (1, 3 and 4)[5] with the main findings summarised as follows:

1. The mean enclosure ratio was 1.73 varying from zero to 3.37.
2. The area and the sum of the length of isovists are all independent of the area of the effective space.
3. The number of axial lines, the sum of the length and the sum of the integration values of the axial lines (strategic value) that interface with the effective space are in proportion to their size.
4. All (100%) axial lines that interface with the effective space are above the mean integration values of the urban system where 60% belong to the 10% integration core.
5. The majority of axial lines interfacing with the main convex element are transverse (T).

The first interesting finding that the study reveals is that, overall, public spaces in the City of London are as enclosed as their European counterparts[6]. However, the way modern squares have been designed, there are some common features regarding their

[4] Refer to Chapter 4.

[5] Items 2 and 5 are the exceptions.

[6] In fact, the sample of contemporary public spaces divides itself into two groups. One group of six public spaces that could be characterised as "exposed" due to low enclosure ratio values. The remaining six cases have high enclosure ratio values as discussed in detail in Section 4.5.1.2 in Chapter 4.

embedding[7]. The high integration values of the axial lines that interface with effective spaces suggest (as for the European traditional urban squares) that the contemporary public spaces are spatially also very accessible in relation to their urban context. In addition, there is a positive relationship between their size and the number of interfacing axial lines.

From the results, an additional finding is that only the spatial properties that were common to both samples were associated to levels of static occupancy. The analysis showed that the number of static people inside the public spaces is independent of public space size, degree of enclosure and convex isovist length and area.

The reason that there is not a correlation between modern public spaces and visibility properties can possibility be attributed to modern interventions creating a reduction of the usable space for static activities. By assigning specific areas for pedestrians (such as pavements) and vehicular movement (roads), modern interventions result in a reduction of "usable" space for static occupancy, with interesting results for the three main sets of properties regarding the "embedding" character. The reduction of "usable" space occurred to the edges. The area of the effective space is smaller than the convex element[8]. However, although smaller, there was little effect on the size of the isovists. The visibility ratio is approximately four times bigger for the effective space and there is no correlation between the area of effective space and isovists. This means that the visual connections between the public spaces and the urban environment are larger than necessary and, probably, the extra areas have no impact on the overall number of static people (this point will be further discussed below).

Finally, it is interesting to observe that for contemporary public spaces, the character of the axial lines is predominately related to through-movement. Transverse axial lines are present in 10 out 12 cases (83%), whereas convergent axial lines are present in 7 out 12 public spaces (58%). It could be rationalised that for the sample of public spaces in the City of London through-movement becomes relatively more important. Here, there is an emphasis for continuity, yet, for traditional squares the priority was termination.

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7 Interesting no note is that not all of them were purposely designed. There are four cases (see Table 4.1 in Chapter 4) which were adapted in sites which were previously used for other functions.

8 The mean area of the effective space is approximately four times smaller than the main convex element.

7.2. ANALYSING AND QUANTIFYING LEVELS OF PEDESTRIAN MOVEMENT AND STATIC OCCUPANCY

One of the major areas of this research is the study of the relation between spatial configuration and levels of static people inside public spaces. Direct observation data showed clearly that levels of static occupancy have a linear correlation with the strategic value[9] of the public space. The analysis has also showed that the sum of the number and the sum of the length of axial lines can be used for the prediction of the number of static people, although the strategic value showed to be the measure that best correlates with levels of static people. To analyse if the strategic value was a robust measure for predicting levels of static occupancy, it was tested in a variety of scenarios, never undertaken previously in such detail. Strong correlations were found for the number of static people according to occupants' categories (suits, suits at pubs ands suits not at pubs). This relationship was constant throughout the day irrespective of the time period (peak and non-peak), month of the year, and was also consistent for public spaces with or without catering facilities.

These findings have important implications. These results confirm that many of the design properties previously thought to be critical for high levels of static occupancy (such as quality of street furniture or lack of vehicular movement) are not significant for the sample in the City of London. Even the enclosure property did not give any indication of the static occupancy level. In addition, the results illustrate that levels of static occupancy are not related to the area of the public space and the visual properties when measured by the area and length of convex isovists. This is quite a surprising result as the perception of public spaces could be related to isovist areas or lengths assuming public awareness leads to static occupation. It is suggested that "peripheral isovist branches" (Fig. 4.2, Chapter 4)[10] common to contemporary public spaces are not relevant for levels of static occupancy similar to axial lines that are adjacent to, but not interface with, public spaces (Hillier, 1984). This brings us back to the discussion of the strategic location based on the relationship between visual (via isovists) and permeability (via axial lines) properties[11]. For traditional squares, there is a correlation between both properties, mainly a strong linear correlation between the sum of the length of axial lines and convex isovist areas. For the sample of public spaces in the

[9] There was no correlation between levels of static people and axial lines (number, length or sum of integration values) according to the C, T and P classification.

[10] Refer to Section 4.4.2, Chapter 4.

[11] Refer to Section 3.5, Chapter 3.

City of London (effect representation), no correlation was found between the two sets of variables[12].

This research claims that the "ideal" number of static people, cannot be measured based on a minimum density of static people per square metre or any other similar relationship. The research has suggested that, against some current ideas (Chidister, 1986), large public spaces can be as successful as small ones. Success, based on the number of static people, can only be best evaluated by comparing a public space with another of the same urban environment. Initially, the linear correlation graph between strategic value and static occupancy should be utilised to evaluate the performance. In the case of the City of London, Abchurchyard (lower strategic value), in the urban context in which it is located, is as successful as Exchange Square (higher strategic value). Although Abchurchyard has a mean static occupancy almost 25 times smaller, they both follow the predicted linear correlation. For both cases, the mean number of static people is a function of the strategic value, as it was for all the other cases of the sample. All twelve selected cases are approximately equally successful. The higher the strategic value the higher the number of moving and static people alike.

The strategic value is a syntactic measure that can be used to evaluate the embedding character of a public space in its urban context. The research has shown that, for a sample of public spaces in the City of London, the relationship between the number of moving people (inside public spaces) and static occupancy is approximately 17 to 1[13]. However, ideally, the strategic value of public spaces should be compared to other examples of the same urban environment. The crucial point is that the number of static people in relation to the strategic value of a public space will naturally change according to its urban context.

Lastly, the results illustrated that, as with levels of static occupancy, levels of pedestrian movement correlate with axial lines properties but not with isovist and enclosure properties. Obviously, levels of pedestrian movement and static occupancy correlate with each other for the public spaces of the City of London. These results confirm that levels of static occupancy are a function of the configuration of the urban fabric as are the associated levels of pedestrian movement.

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[12] The two sets of variables are the area and the sum of the length of convex isovists and the sum of the number, length and integration values of axial lines. Refer to correlation matrixes, Tables 3.4 (Appendix 1) and 4.6 (Appendix 2).

[13] Refer Table 5.10 in Chapter 5.

7.3. ANALYSING AND QUANTIFYING PATTERNS OF PEDESTRIAN MOVEMENT AND STATIC OCCUPANCY

The study suggested that while there was a good correlation for levels of pedestrian movement and integration values of axial lines along linear spaces (streets), meaning that people tend to follow the most direct routes, this property was not found inside public spaces. Although the research has showed that the level of pedestrian movement is a function of the configuration of the urban grid (as suggested by the correlation between levels of pedestrian movement and the strategic value), it was worth further investigating patterns of pedestrian distribution inside pubic spaces.

For the interface between users and public spaces, it is suggested that pedestrian routes inside public spaces are the only category that is less dependent on the configuration of the urban fabric. Although the configuration of the grid plays a role as it establishes points of access; the decision to cross the public space between destinations and which route to take when inside, is a function of the internal configuration of the public space. The distribution of moving people inside public spaces is primarily determined by the degree of complexity of the internal layout. Therefore, the internal layout and placement of decorative elements were found relevant for patterns of pedestrian distribution but not for levels of static occupancy. People will avoid crossing public spaces between destinations unless no viable alternative route is available and the deviation is too lengthy. The comparative analysis between Bank Corner and Fenchurch Place, public spaces with similar shapes but significant differences at micro level, illustrated how in the first case part of the pedestrian movement deviates to the surrounding pavement, in contrast to Fenchurch Place, which works as a transitional space between destinations.

The research showed that isovists are an important element in the assessment of the distribution of stationary people inside public spaces. The study started from the hypothesis that users of public spaces tend to place themselves in areas near or viewing distance of the locations from which they entered the space. A series of point isovists drawn from axial line intersection points (instead of convex isovists from within the public spaces) are projected inside the public spaces and overlaid, resulting in convex spaces with different degrees of visual exposure (coverage density levels) to the surrounding grid resulting in, what was named, overlapping point isovists maps.

The analysis, by overlaying static people on the overlapping point isovists maps, showed that the preferred location for static occupancy is inversely related to coverage density, and that this property is the crucial factor independent of the time of day and of the activities people are engaged in. Three activities, eating and/or drinking, reading and relaxing were measured. In all cases, the preferred areas for the different activities were the same, that is, there were more people sitting or standing in areas of low coverage density, followed by medium coverage density and areas with high coverage density contained the smallest number of people. In addition, the analysis of preferred areas for static occupancy indicated that, although there is a higher incidence of people in less visually exposed spaces, there is a preference for locations with direct visual access of high coverage density areas. The research also showed, likewise levels of static people, the static distribution should not be based on density.

The results confirm Whyte's (1980), and Gehl's (1987) suggestions that we are not keen on being exposed and we select areas that provide a combination of a certain degree of privacy combined with good visual fields, although so far there is no effective methodology that could quantify this trend. In addition, these results suggest that despite the findings that axial lines tend to intercept each other at the periphery of public spaces and Hillier's suggestions (et al., 1990a) that popular areas for static occupancy are close to the intersection of axial lines, in line with the edge effect (Gehl, 1987 and Alexander, 1977), such trend was not found for the sample. Firstly, the idea that people prefer to sit in areas overlooking high levels of pedestrian movement is not necessarily a rule, the edge effect might happen but ultimately it is a result of the relationship of the public space and the configuration of the urban grid. Also, claims that people select areas according to the activities in which they are engage were not found to be true for this research.

Also, Whyte's ideas (1980) regarding the "clustering" property as people attract more people can also be questioned based on the results. The results suggest that the clustering property is also a function of convex space coverage density. People may select areas with large visual fields from within the public spaces but the key element is to be visually less exposed to the surrounding urban area. Valentine (1998) suggests that the "gaze" (Foucault, 1973) "as a mechanism of disciplinary power – plays an important role in producing appropriate public bodily performances" (Valentine, op. cit., 195), which might explain the desire for privacy, although this issue was not explored in this thesis.

7.4. EPILOGUE[14]

To investigate the relationship between spatial configuration and patterns of spatial use of public spaces, empirical data was collected for a group of twelve public spaces in the City of London. From the fieldwork, it was possible to study the general patterns of static occupancy. It was found that the distribution of static occupancy had a unique character throughout the day with an early morning increase before 9 am, and the main peak at lunchtime. In addition, there is one major difference between public spaces with and without wine bars. While for public spaces with wine bars, levels of static occupancy increase after 5 pm (with numbers of static people almost as high as during the lunchtime period), for those without wine bars, levels of static occupancy, in comparison, are much lower. Several additional important observations were gathered from the fieldwork. For example, public spaces are effectively used before a typical working day commences. Also, a large number of people do not return to work after lunch by staying in the public space until late afternoon. It was also interesting to find out a variety of activities that can take place inside public spaces; from relaxing and people watching to other kinds of activities such as celebrating birthdays or business meetings.

Many rooted ideas were challenged. It is suggested that small public spaces do not perform better than larger ones; retail takes advantage of the natural levels of static occupancy; the lack of vehicular movement, tall buildings, spatial enclosure, decorative elements, ergonometric seats are complementary factors[15] rather than determinant components. In fact, this research investigation suggests that ideas derived from attraction theories and architectural determinism do not constitute a solid base for understanding the functioning of public spaces.

It is clear from this research that ideas which claim that public spaces should follow the design of traditional urban squares in order to be successful can be misleading, when referring only to spatial enclosure, irregularity of spatial forms and richness of decorative elements. Back in 1909, Unwin criticised the idea of copying the design of traditional places without a purposeful reason. This study claims that although traditional urban squares, at least to contemporary eyes, have a picturesque character and might appeal to us as the right solution for achieving lively and dynamic public spaces, by

[14] The first two illustrations at the end of this chapter were taken from Morris, 1994 and the following from Kostof, 1992.

[15] The research does not devalue their importance.

neglecting the relationship between public space and urban grid, there is no guaranty that they will be successful. In simple terms, it is suggested that a less sophisticated[16] public space in areas with high levels of pedestrian movement will present higher levels of static occupancy than a sophisticated space in areas with low levels of pedestrian movement. The understanding of the structure of the configuration of the urban fabric in which future public spaces are to be located should be a key issue in further studies.

The variables that have been identified for their success arise from the relationship between use patterns and spatial configuration. The research reinforced Hillier's findings on strategic value as a measuring tool for levels of static occupancy. It was also concluded that levels of pedestrian movement can be quantified according to the strategic value. In addition, it was suggested that the preferred location for static activities is a function of the levels of visual exposure of the different areas of the public space in relation to the surrounding grid. Although this research considered public spaces in the financial district of the City of London, because space syntax methodology has been successfully used for the morphological analysis of different sectors of the urban environment (such as commercial and residential areas) it is suggested that the findings of this research (such as the strategic value or levels of coverage density of point isovists which are derived from the space syntax methodology) can be used to evaluate the performance of public spaces in other urban environments.

Naturally, the relevance of these findings is their applicability in the design of public spaces. If we are to design a public space in a commercial area, for instance, the analysis should always start by understanding the configuration of the urban grid in which it will be embedded with an accurate axial break-up model of the area. Then by carrying out an analysis of the performance of other existing public spaces in adjacent areas with respect to their levels of static occupancy and respective strategic values, an initial indication of how public spaces perform can be envisaged. Subsequently, by constructing another axial model of the area but incorporating the proposed public space, it is possible to compare the strategic value of the new proposal to the data of the adjacent public spaces. Now it is a relatively simple procedure to quantify the potential number of users for the new scheme. Depending on the proposal's brief, the design of the public space can be modified to fulfil its function by adding or prolonging the permeability and visual connections to the surrounding grid to increase the levels of

[16] In this case, "sophisticated" indicates a public space designed according to the parameters suggested by authors who looked at the quality and quantity of street furniture.

static occupancy. The designer should thus be able to produce the best model for its context and requirements using the space syntax methodology.

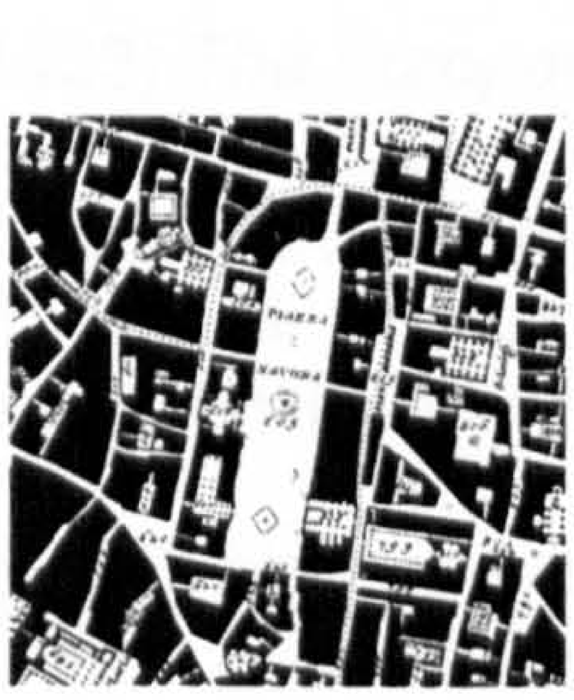
Once satisfied, the designer can move to the fine-tuning of the design, by studying the preferred areas for static occupancy and pedestrian routes. If the strategic value is the best method for quantifying the levels of pedestrian movement and static occupancy, the distribution of static people can be predicated using the overlapping point isovists analysis.

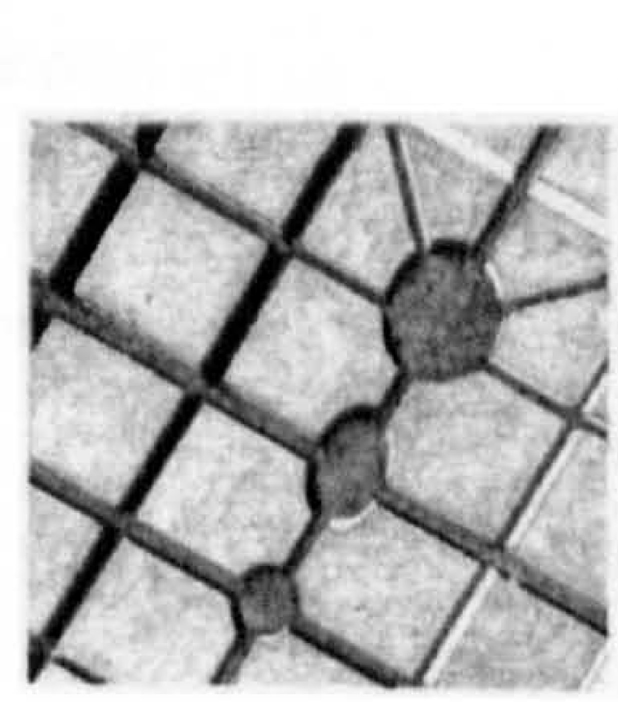
The knowledge of preferred areas for static activities can assist designers in all aspects of detailed planning. Adequate seating can be allocated in areas that are likely to receive the largest amounts of people. Also, it might be advantageous to locate retail stores in areas with high levels of static occupancy. From the information about the areas likely to receive the lowest amount of people, designers can concentrate on the location of decorative elements or other amenities such as mail boxes, meeting points or access to an underground station. In addition, from the study of the distribution of static people, it would possible to identify the percentage of static people for convex spaces according to the coverage density levels. Based on the predicted number of levels of static people (from the strategic value) it is then possible to quantify the potential number of users for the different areas according to their levels of coverage density. This information can thus be used for planning the amount of seating or as a reference for the number of users for retail establishments.

Finally, this research project did not only contribute in establishing theoretical models to predict the performance of public spaces. This research also developed new effective methods of data collection. The "following-up" people methodology as a percentage of levels of pedestrian movement proved crucial for a true representation of patterns of pedestrian movement. The static distribution graphs have shown that the time period for the data collection is critical to obtain accurate information on levels of static people.

Several new ideas were introduced regarding the representation of public spaces. For example, for traditional urban squares where detailed information of the urban form is not available, the convex container representation showed effective for the study of their morphology. The classification of the axial lines was a useful tool for the characterisation of spatial enclosure and functional determinants in public spaces, as well as for patterns of pedestrian movement. Also, the quantification of the integration values of the public spaces and later comparison to axial lines of the urban grid showed to be very useful for understanding how the public spaces function at the collective level of the urban system. Finally, the overlapping point isovists analysis developed to study the distribution of static occupancy proved effective and innovative. It is hoped that this can be useful for the analysis of both buildings and urban places.

What spatial properties are relevant to the success of urban public spaces? This research has outlined several approaches for describing and quantifying levels and distribution of pedestrian movement and static occupancy of public spaces. The important emphasis from this study is that there are many ways of creating good and vibrant public spaces. However, the impact of a successful public space is not limited to its spatial boundaries. Lively public spaces imply lively urban areas and consequently can only add to the vitality and success of our cities as a whole.





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APPENDIX 1

THE MORPHOLOGY OF URBAN SQUARES OF EUROPEAN TOWNS

Plate 3.1. Plans of selected European towns (1/5)

plans not in scale
for illustration only

urban square

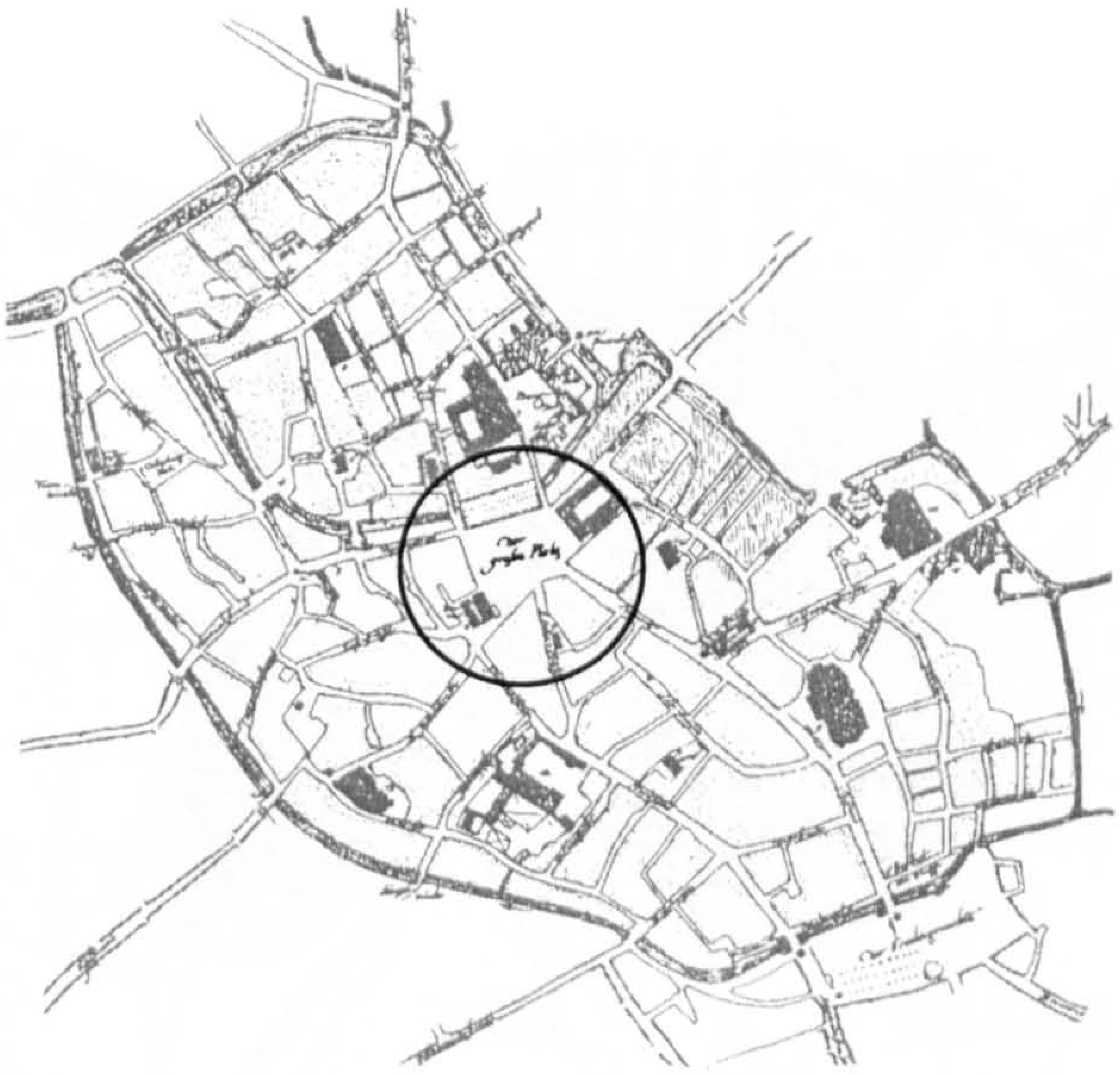


Fig. 1. Bruges - Belgium
1562 plan
Gutkind, 1970

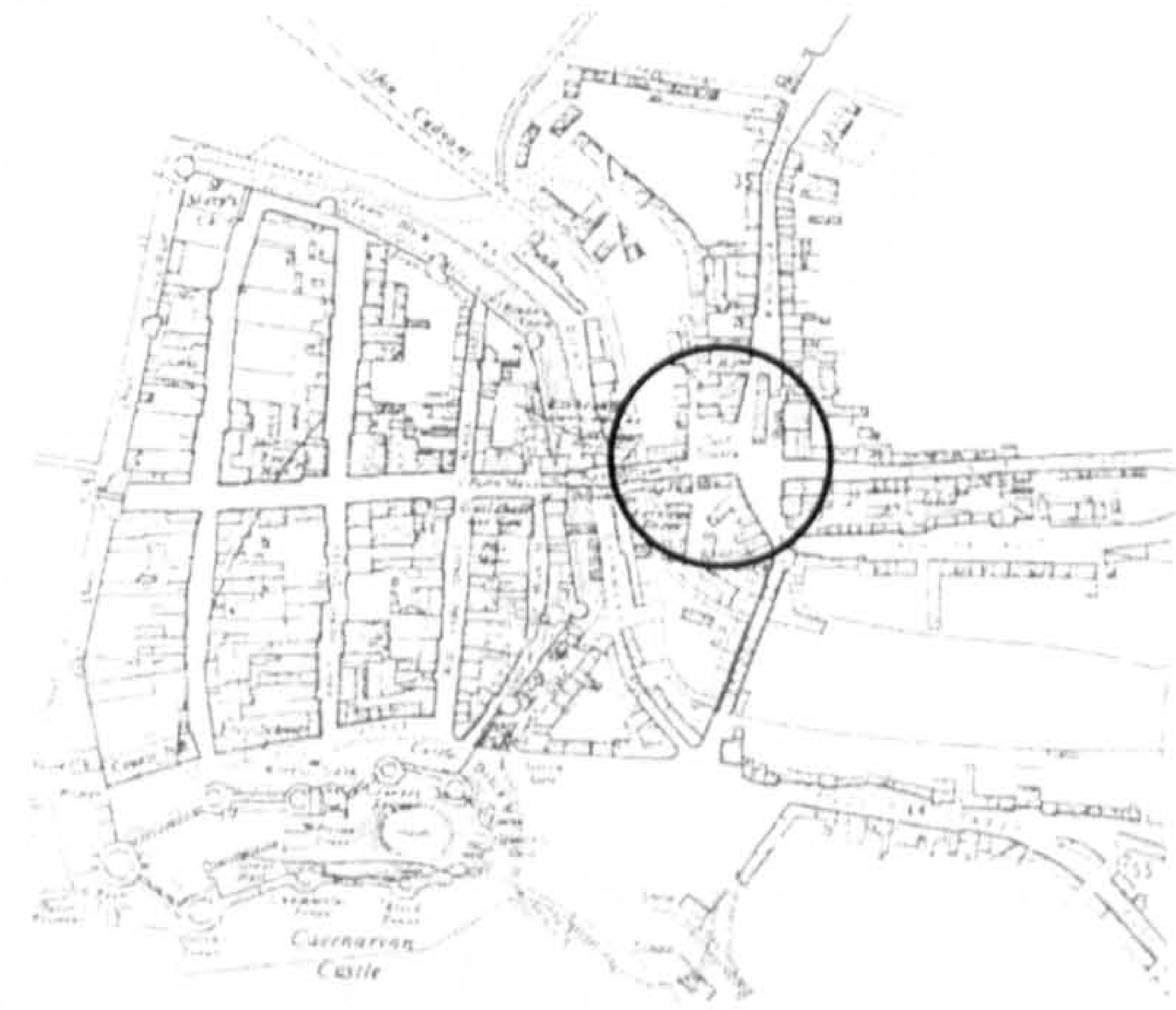


Fig. 2. Caernarvon - UK
circa 1000 plan
Lobel, 1975

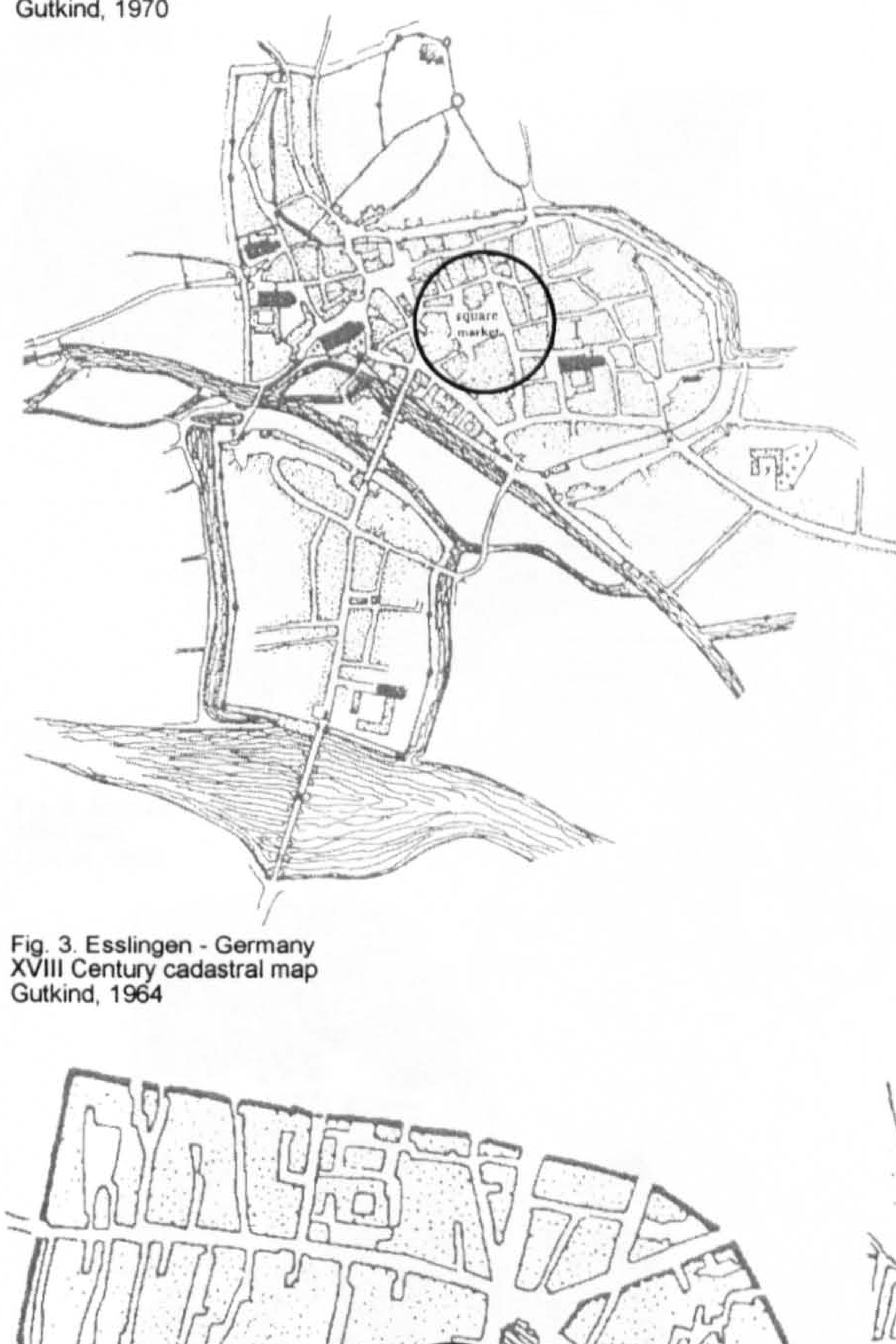


Fig. 3. Esslingen - Germany
XVIII Century cadastral map
Gutkind, 1964

Fig. 4. Evora - Portugal
XIX map
Mil. Geo. Studie, 1941

Fig. 5. Heilbronn - Germany
XVIII Century cadastral map
Gutkind, 1964

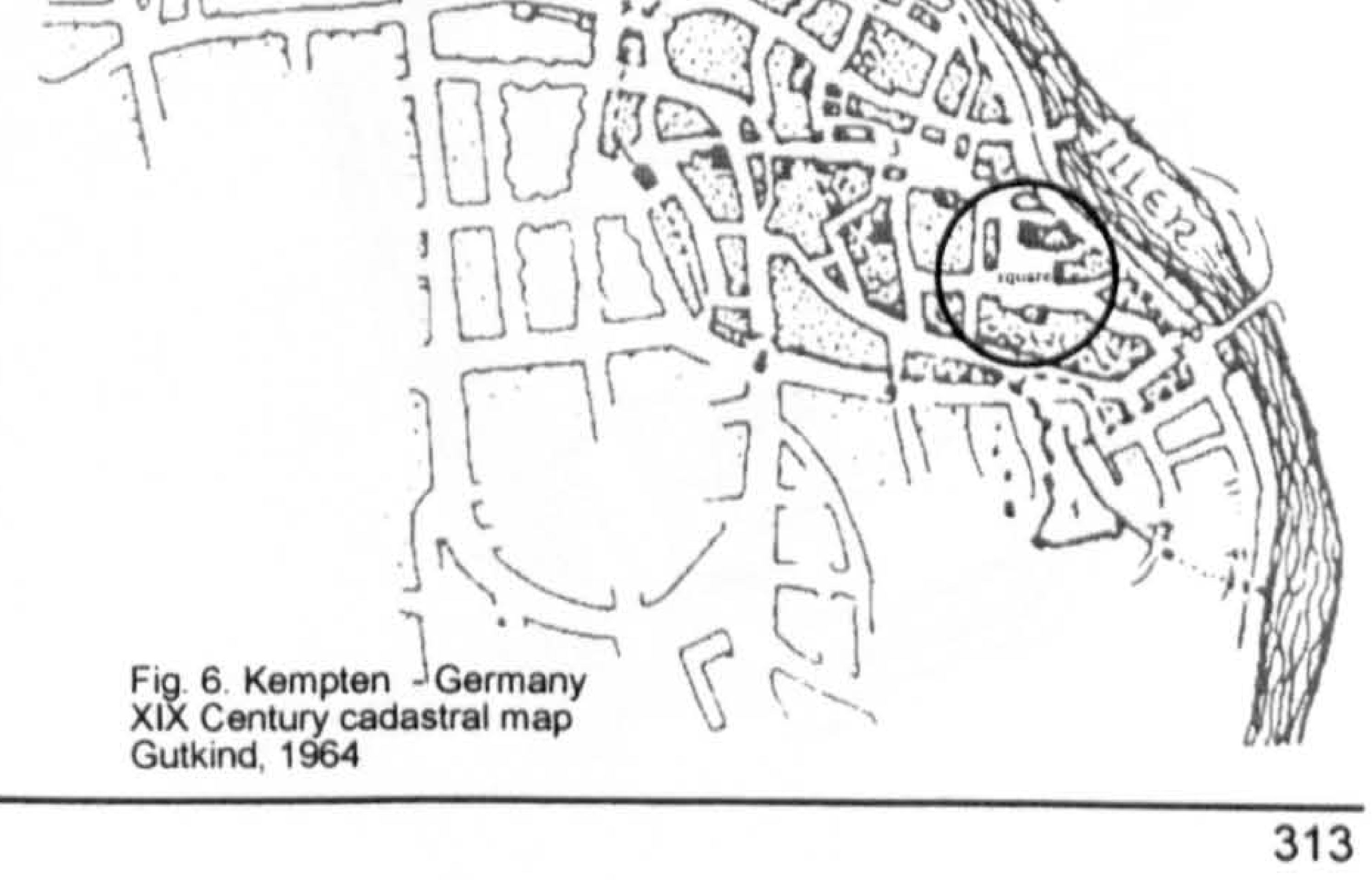


Fig. 6. Kempten - Germany
XIX Century cadastral map
Gutkind, 1964

plans not in scale
for illustration only

urban square

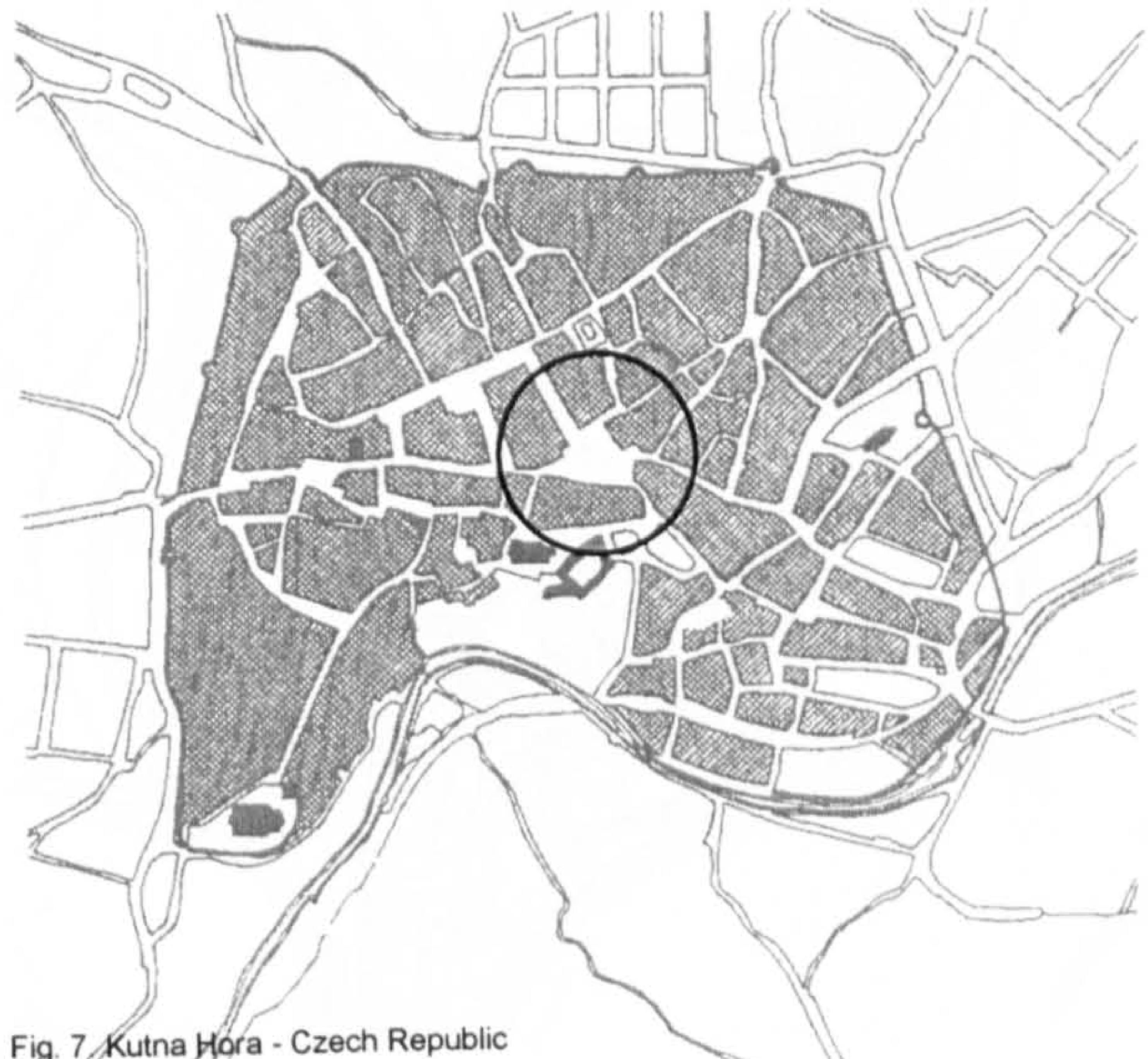


Fig. 7. Kutna Hora - Czech Republic
1839 plan
Gutkind, 1972

Fig. 8. Magdeburg - Germany
XVIII Century cadastral map
Gutkind, 1964

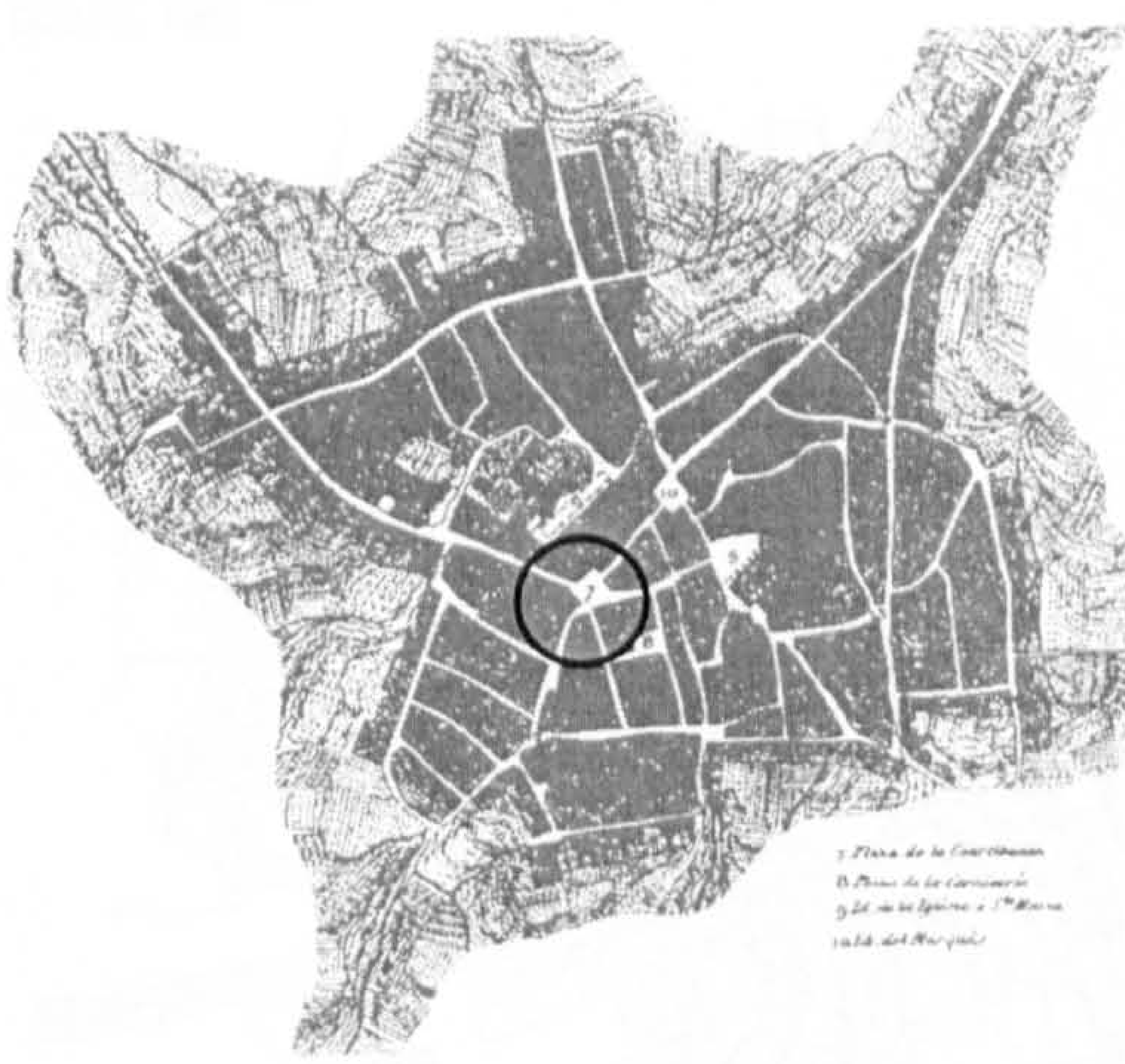


Fig. 9. Moguer - Spain
1869 plan
Linares, 1991

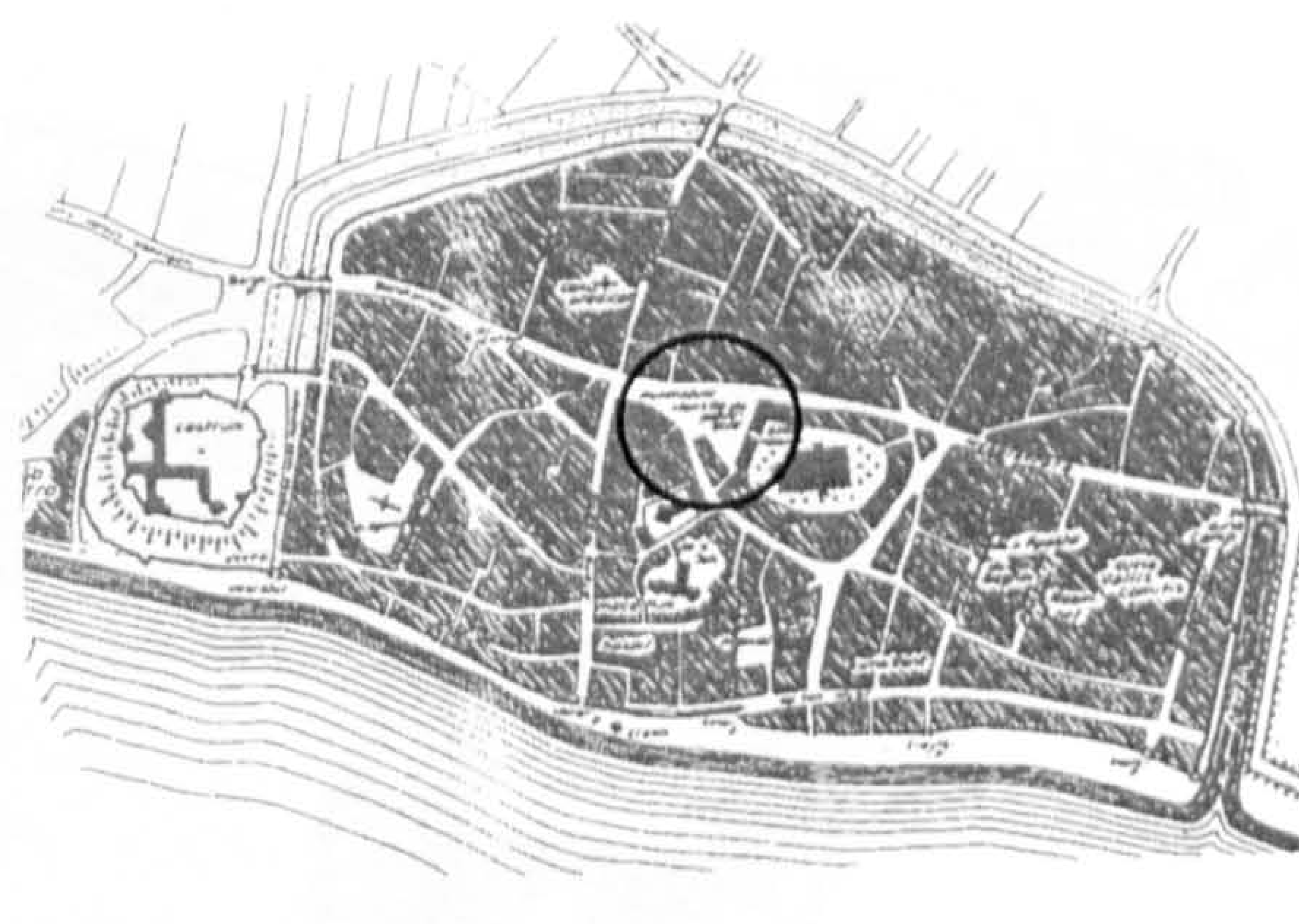
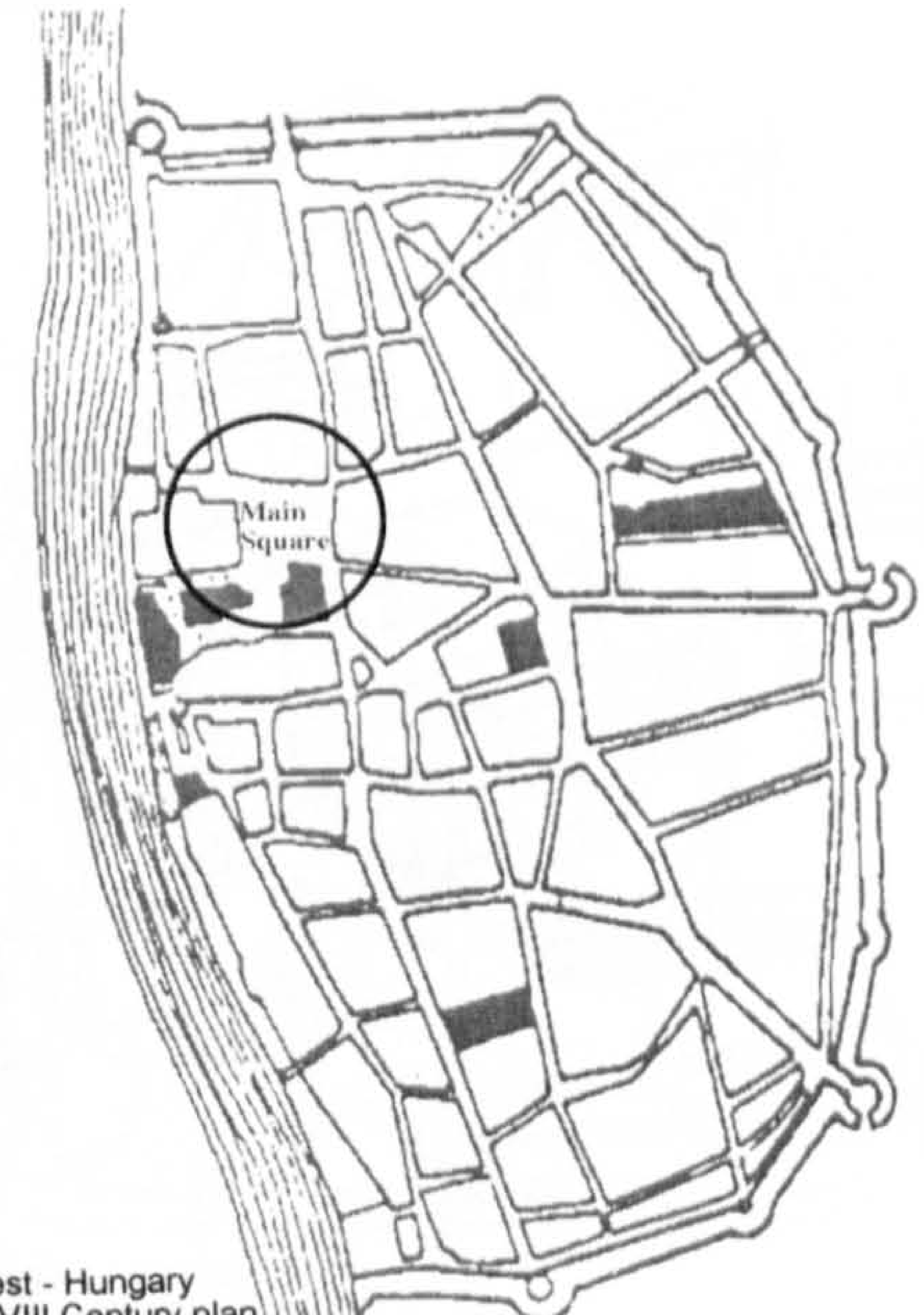


Fig. 10. Nijmegen - Netherlands
XVI Century map
Gutkind, 1971

Fig. 11. Palencia - Spain
1852 plan
Linares, 1991



12. Pest - Hungary
Fig. XVIII Century plan
Gutkind, 1972

plans not in scale
for illustration only

urbansquare

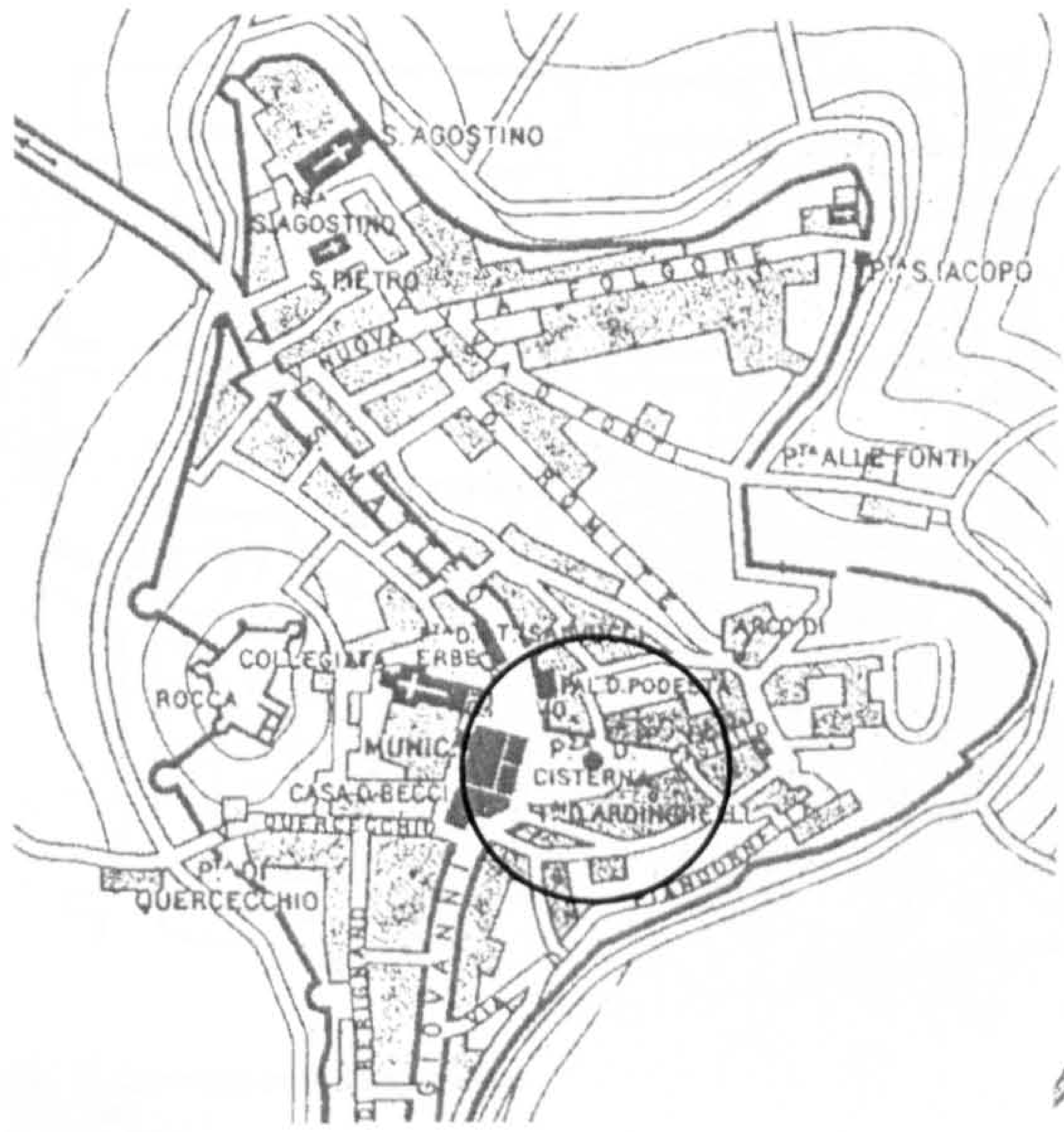


Fig. 13. San Gimignano - Italy
XVIII Century cadastral map
Gutkind, 1969

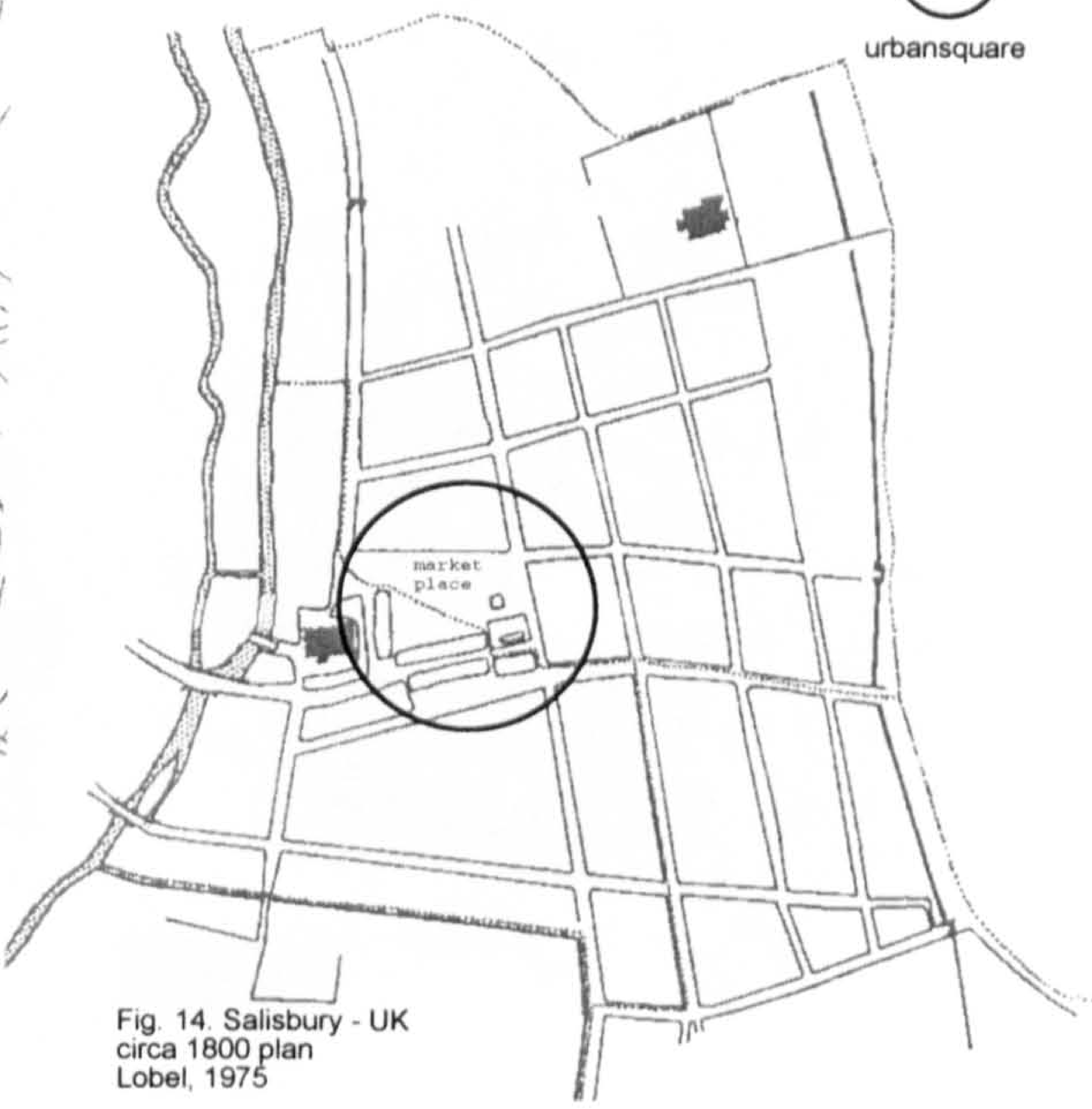


Fig. 14. Salisbury - UK
circa 1800 plan
Lobel, 1975

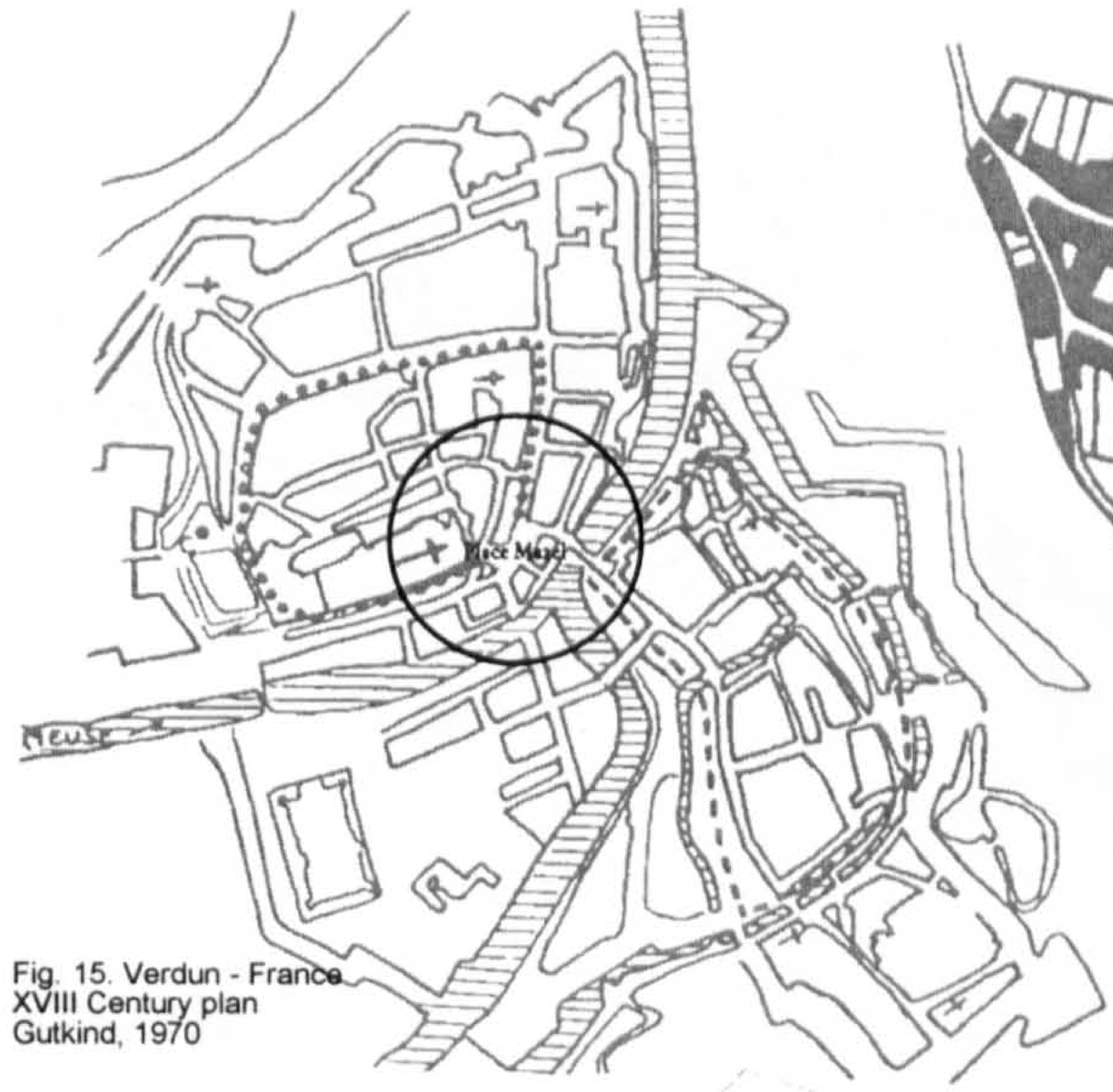


Fig. 15. Verdun - France
XVIII Century plan
Gutkind, 1970

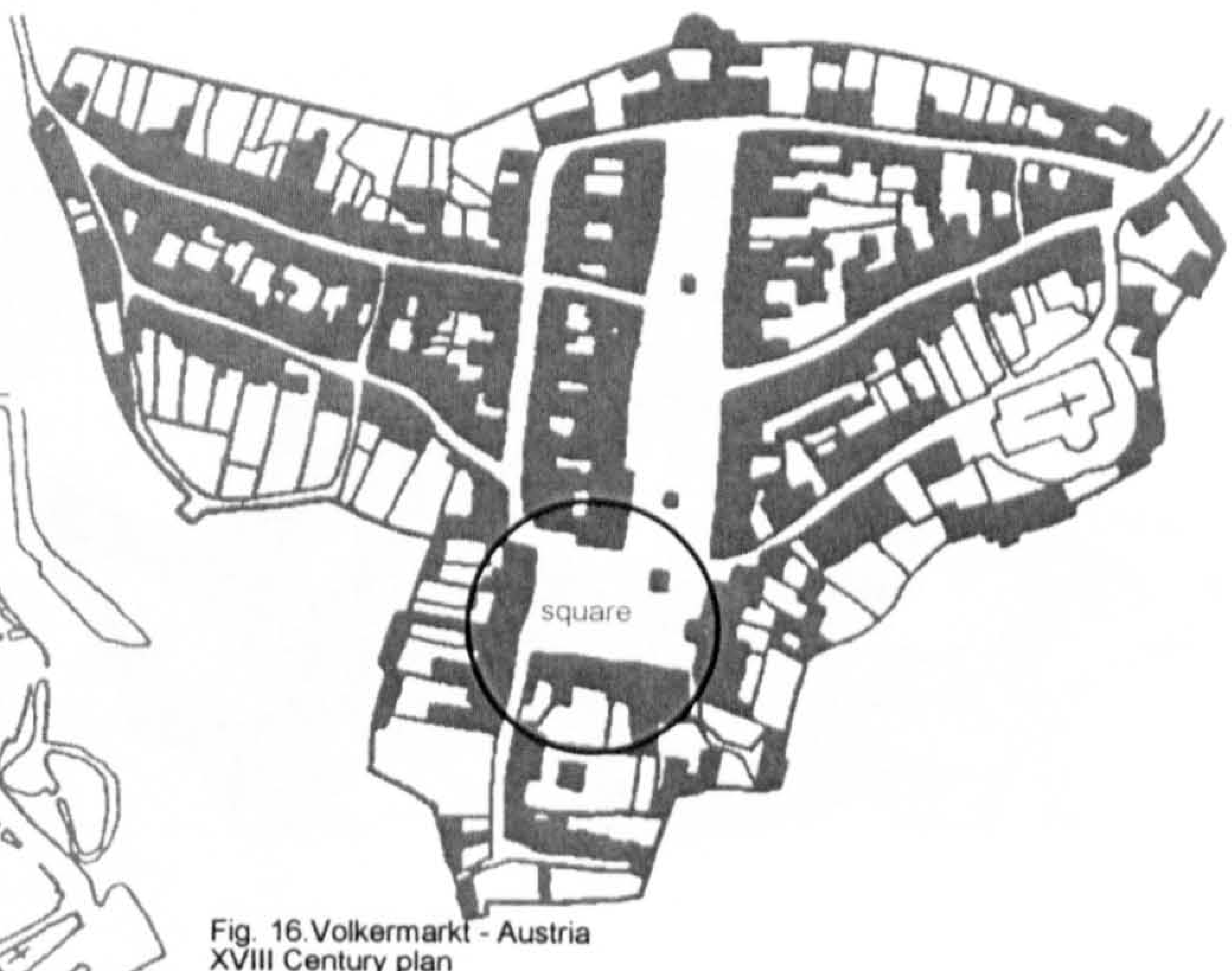


Fig. 16.Volkermarkt - Austria
XVIII Century plan
Gutkind, 1965

Fig. 17. Borgomanero - Italy
XIX Century cadastral map
Friedman, 1988

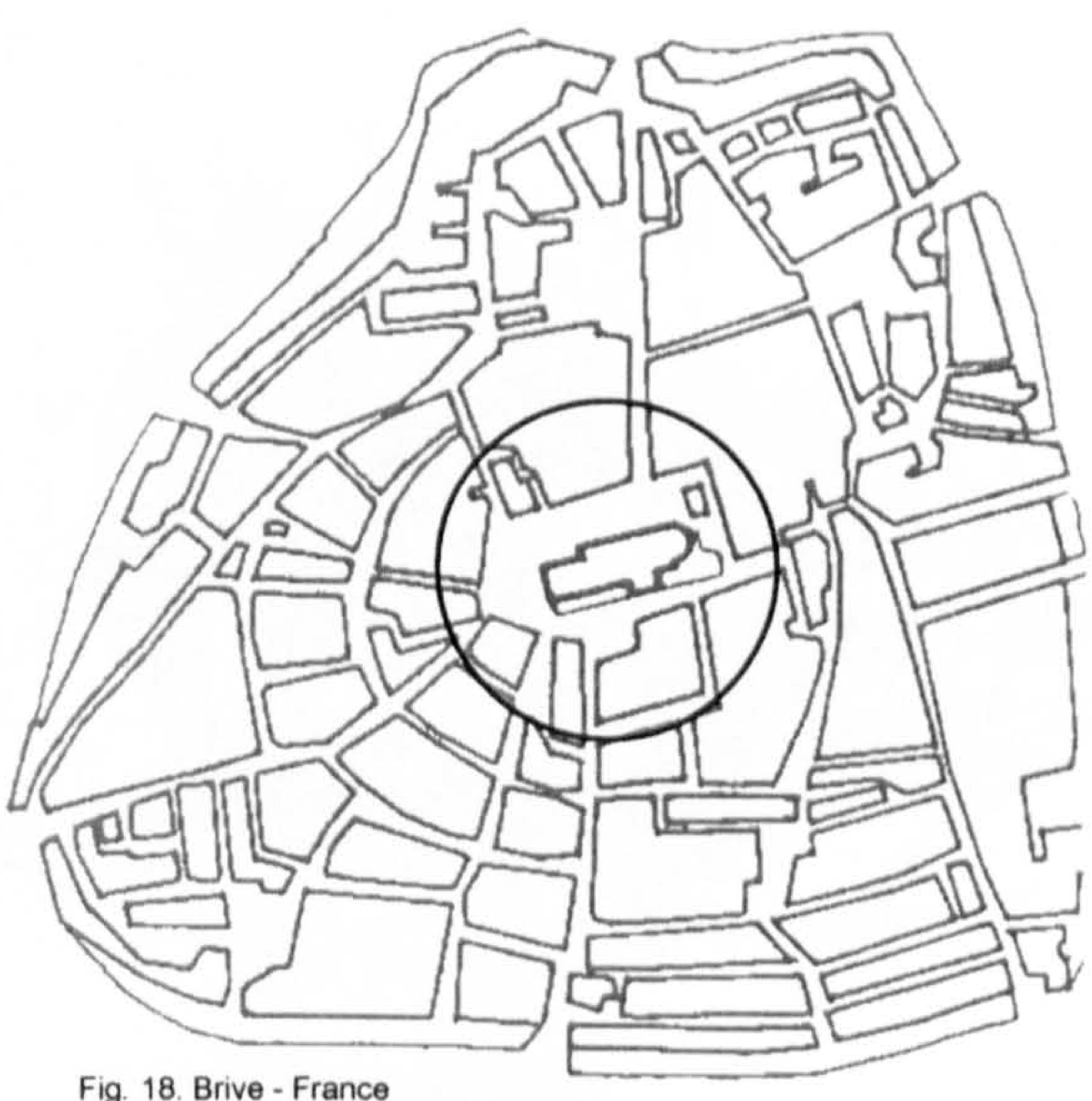


Fig. 18. Brive - France
XVIII Century plan
Gutkind, 1970

plans not in scale
for illustration only

urban square

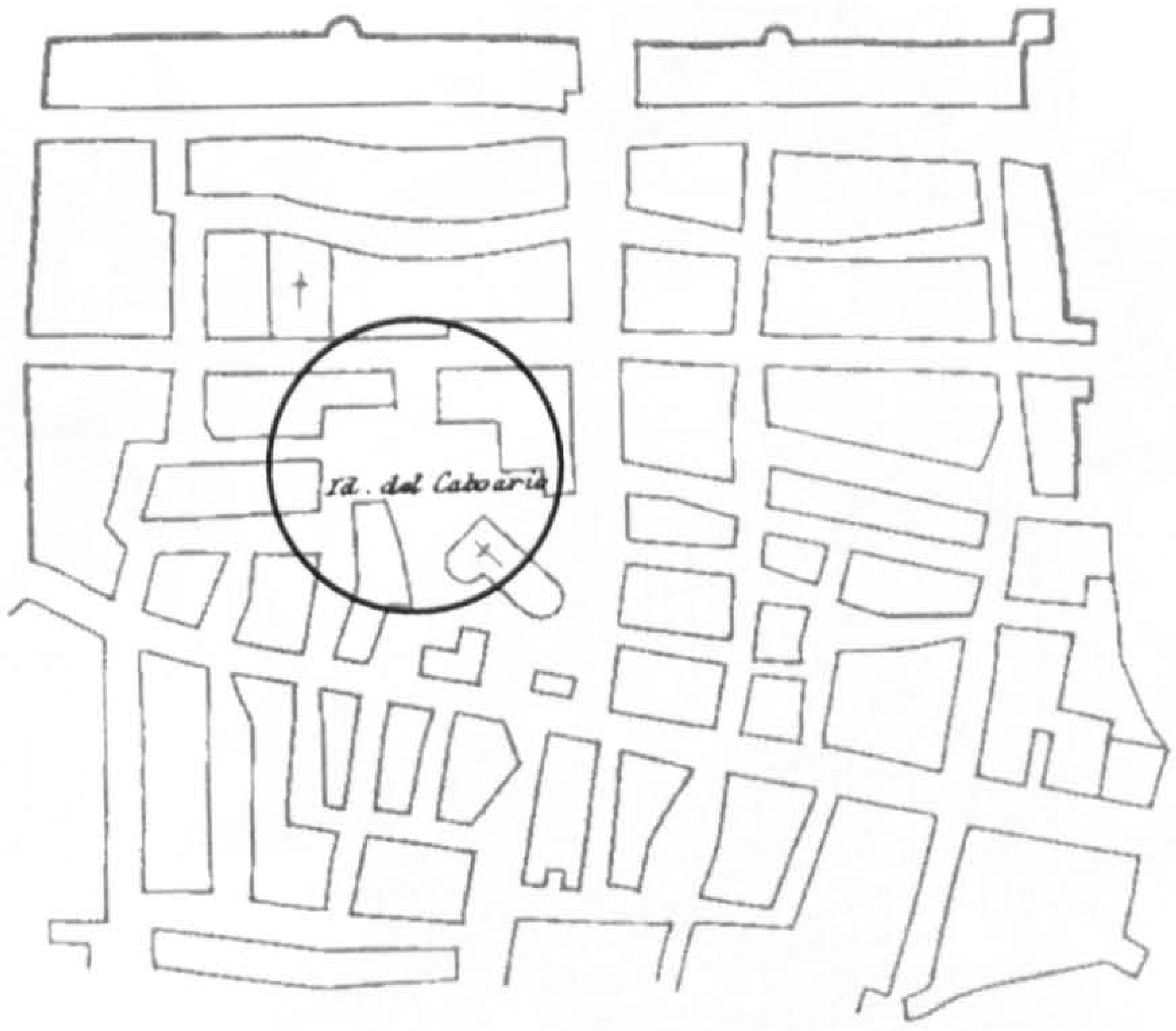


Fig. 19. Castellon de la Plana - Spain
1852 plan
Linares, 1991

Fig. 20. Groningen - Netherlands
XVI Century plan
Gutkind, 1971

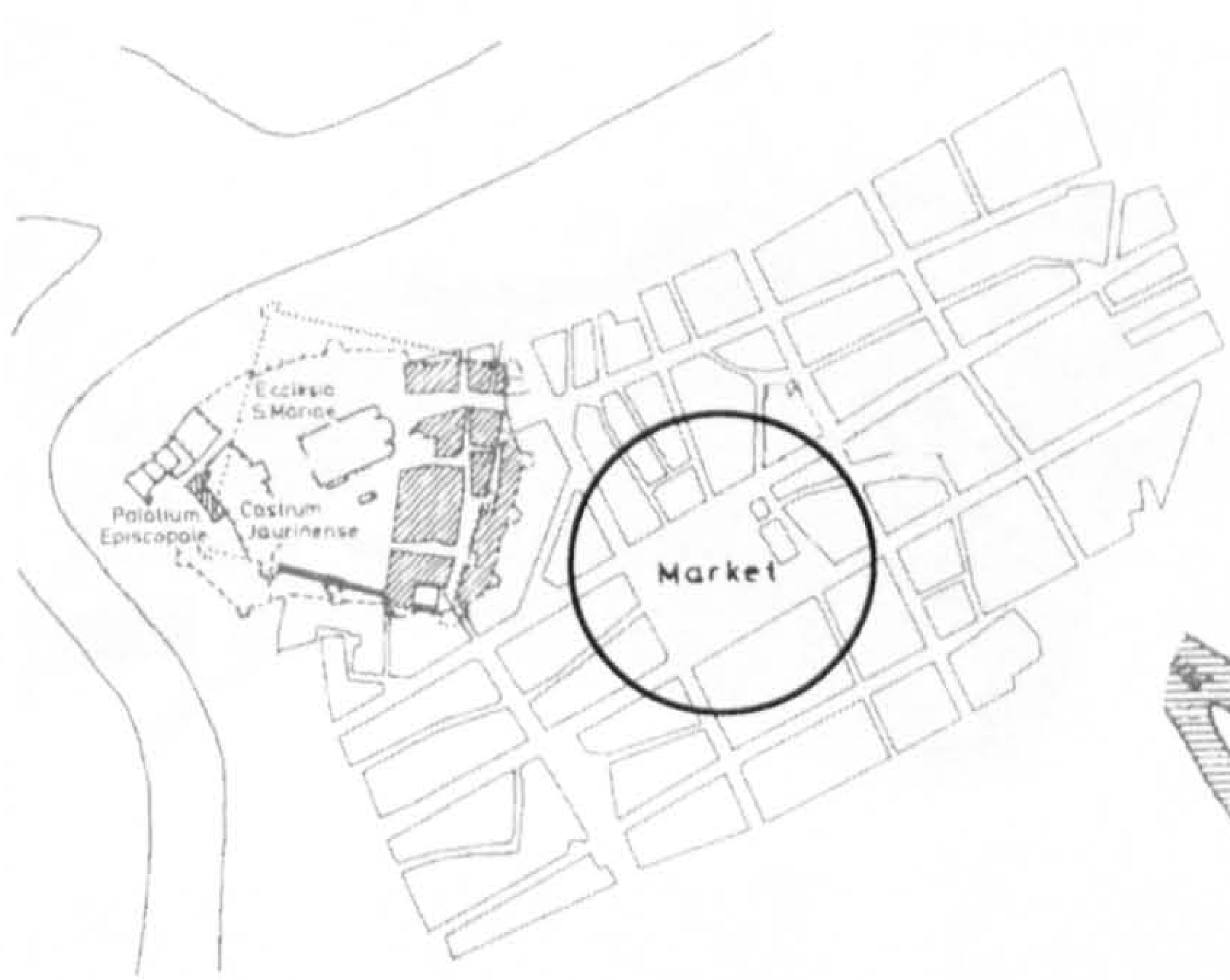


Fig. 21. Gyor - Hungary
XIII Century plan
Gerevich, 1990

Fig. 22.Kalisz - Poland
1785 plan
Gutkind, 1972

Fig. 23. Klatovy - Czech Republic
1837 cadastral map
Gutkind, 1972

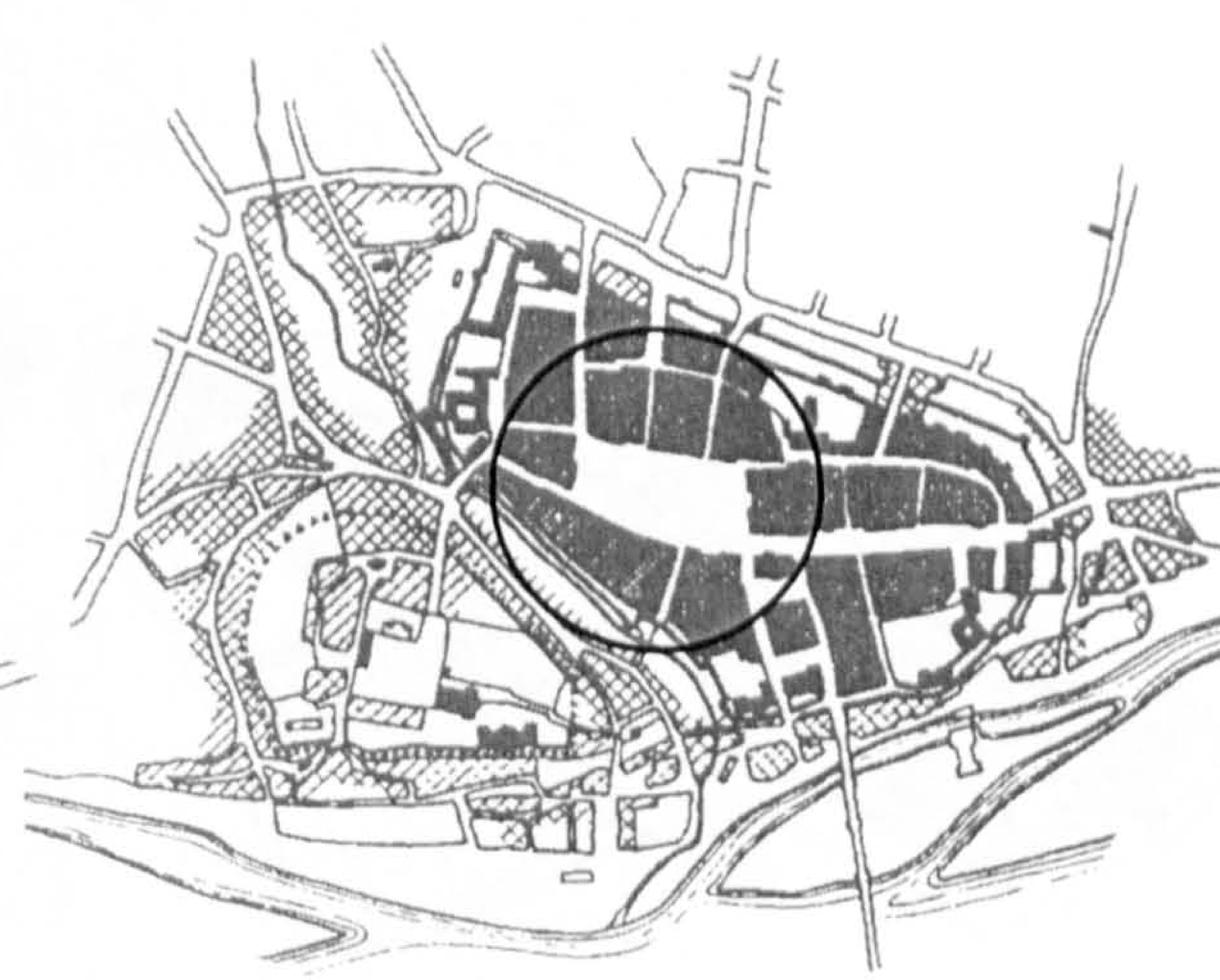


Fig. 24. Litomerice - Czech Republic
XVIII Century plan
Gutkind, 1972

plans not in scale
for illustration only

urban square

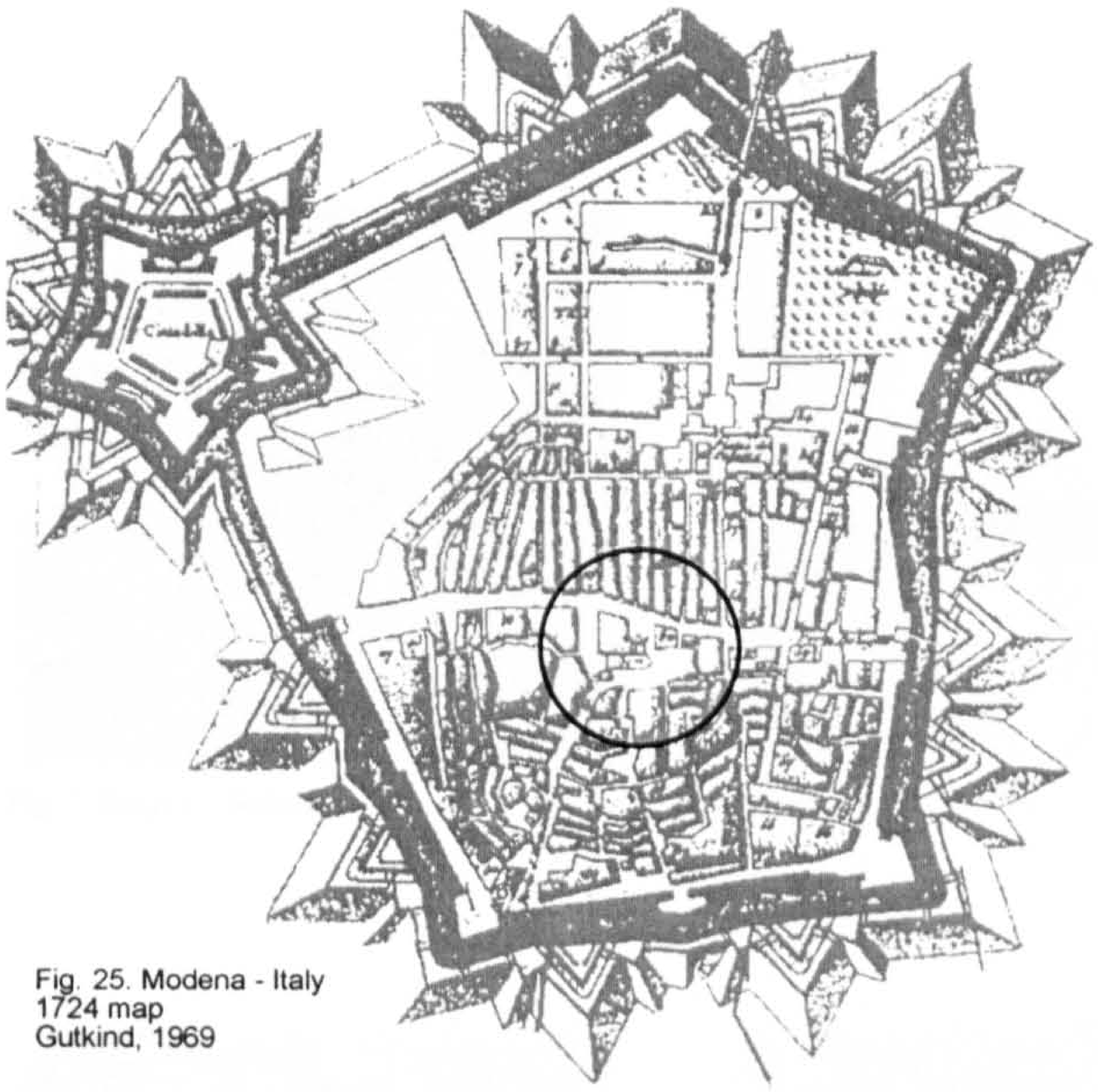


Fig. 25. Modena - Italy
1724 map
Gutkind, 1969

Fig. 26, Mountauban - Frane
circa XVII Century plan
Gutkind, 1970

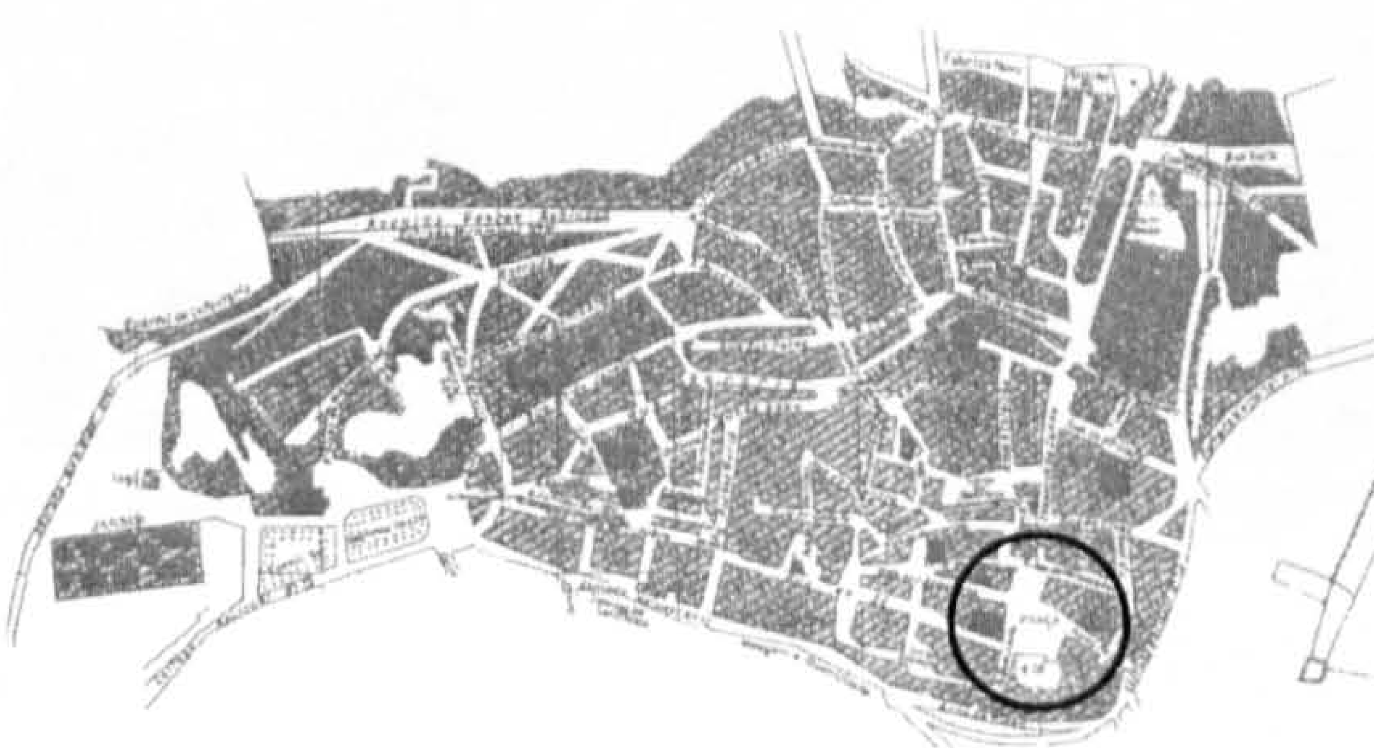


Fig. 27. Portalegre - Portugal
XIX Century map
Mil. Geo. Studie, 1941

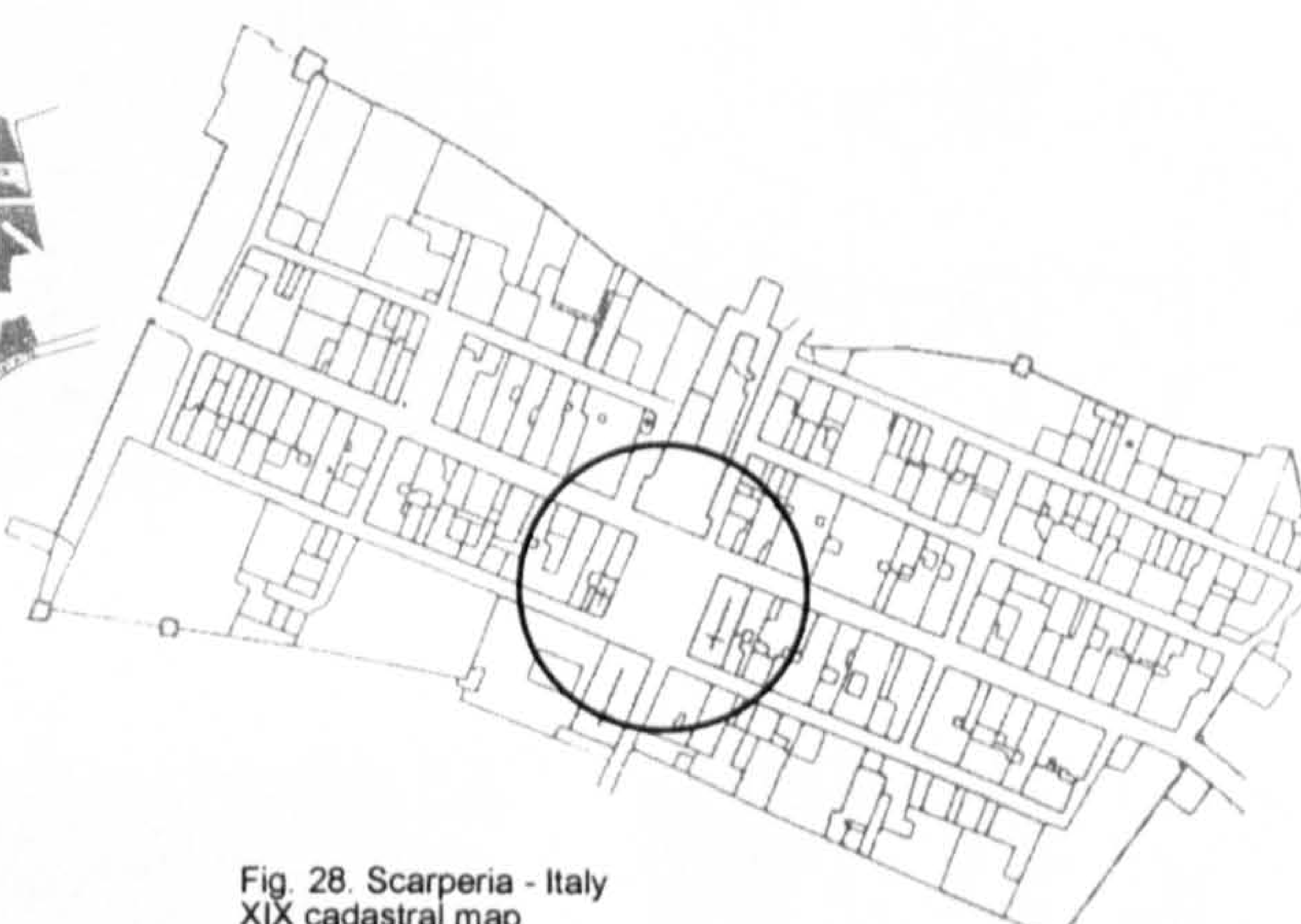


Fig. 28. Scarperia - Italy
XIX cadastral map
Friedman, 1988

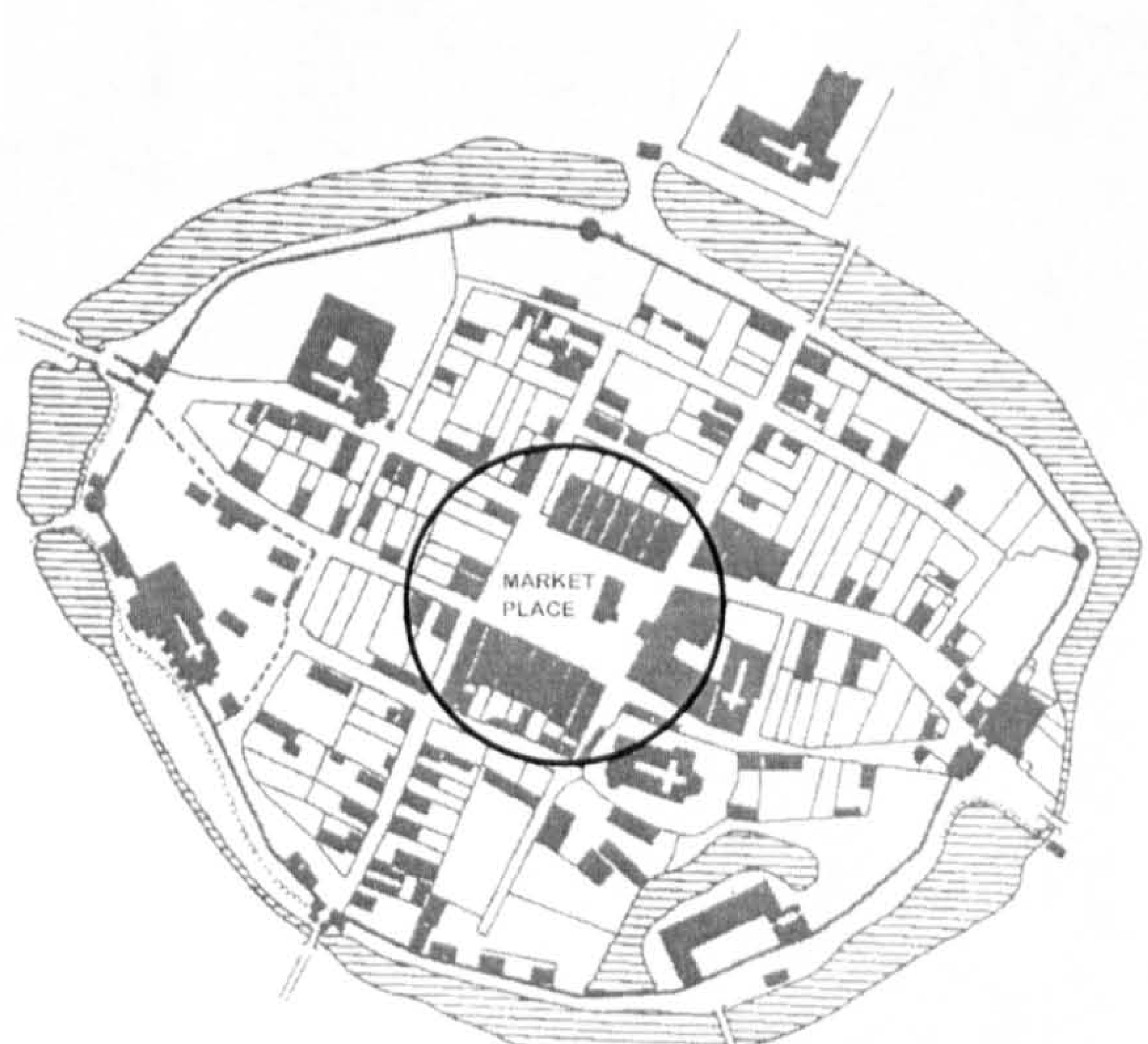


Fig. 29. Wielun - Poland
1799 map
Gutkind, 1972

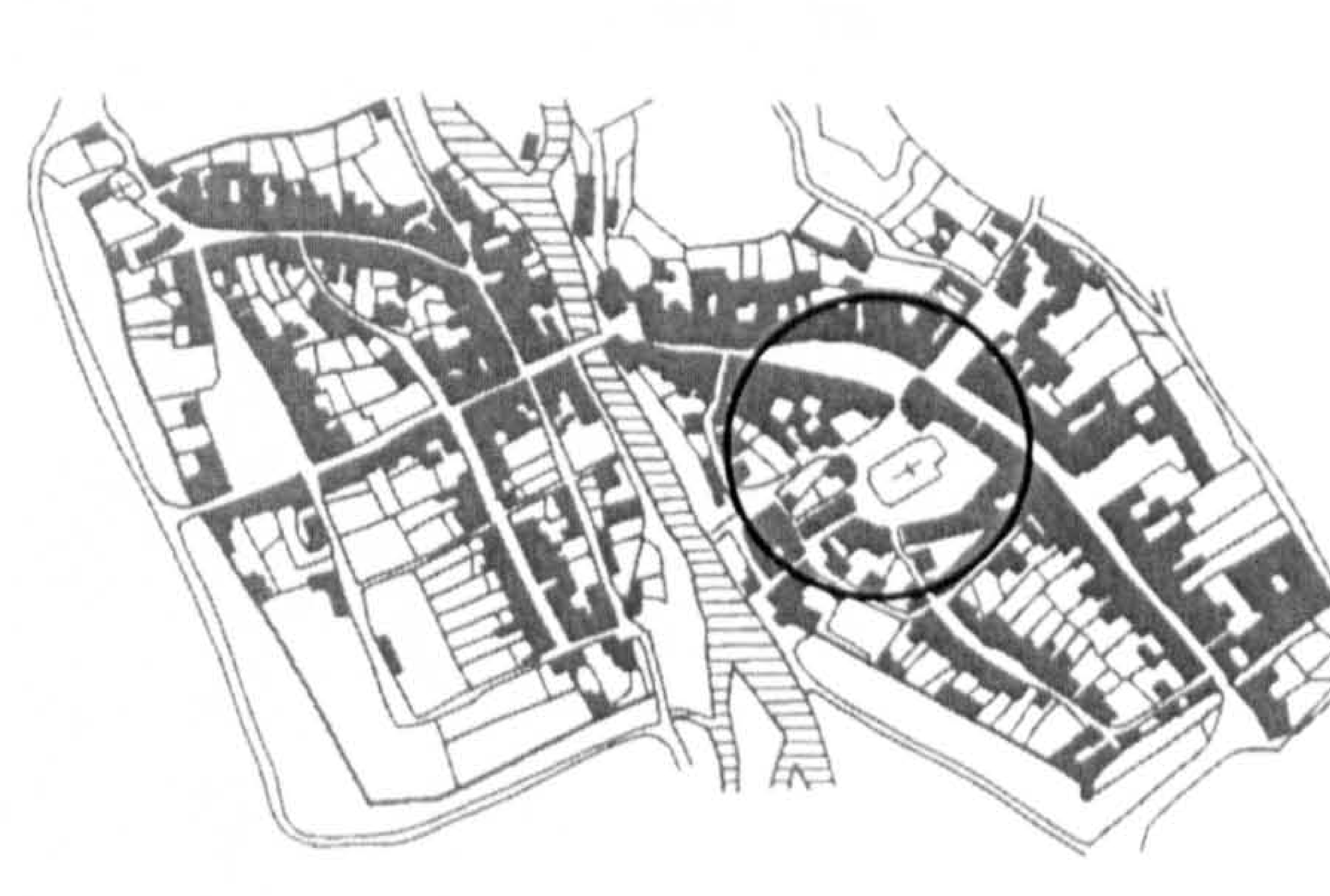


Fig. 30. Wolfsberg - Austria
XVIII Century plan
Gutkind, 1965

Plate 3.2. European towns convex break-up (1/3)

plans not in scale
for illustration only

convex break-up
main convex element
urban blocks

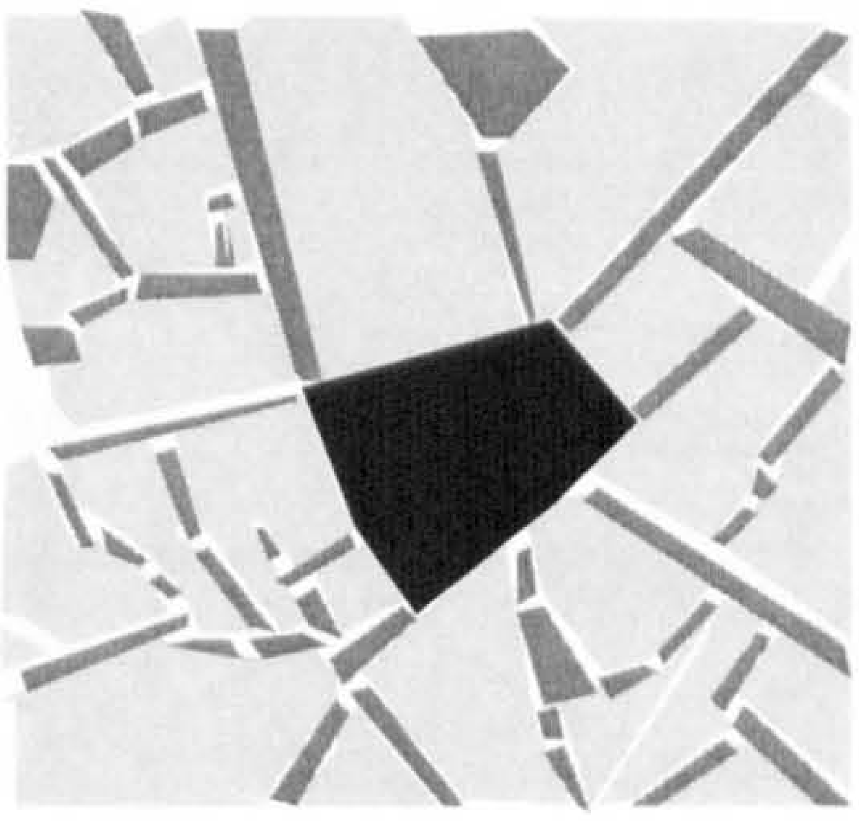


Fig. 1. Bruges - Belgium

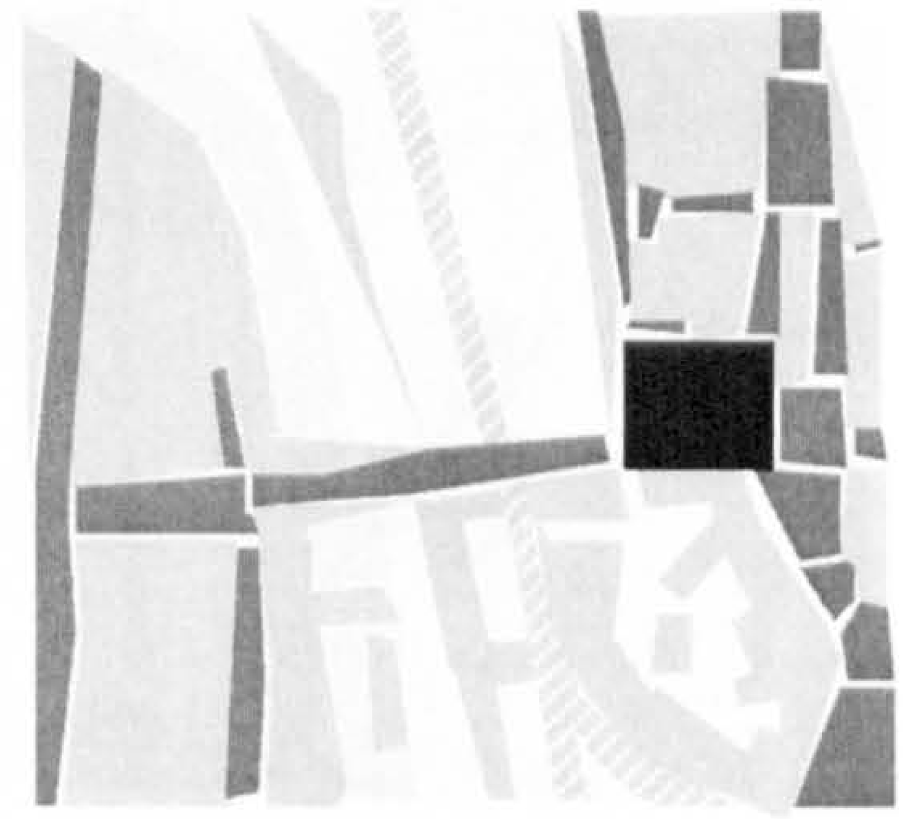


Fig. 2. Caernarvon - UK

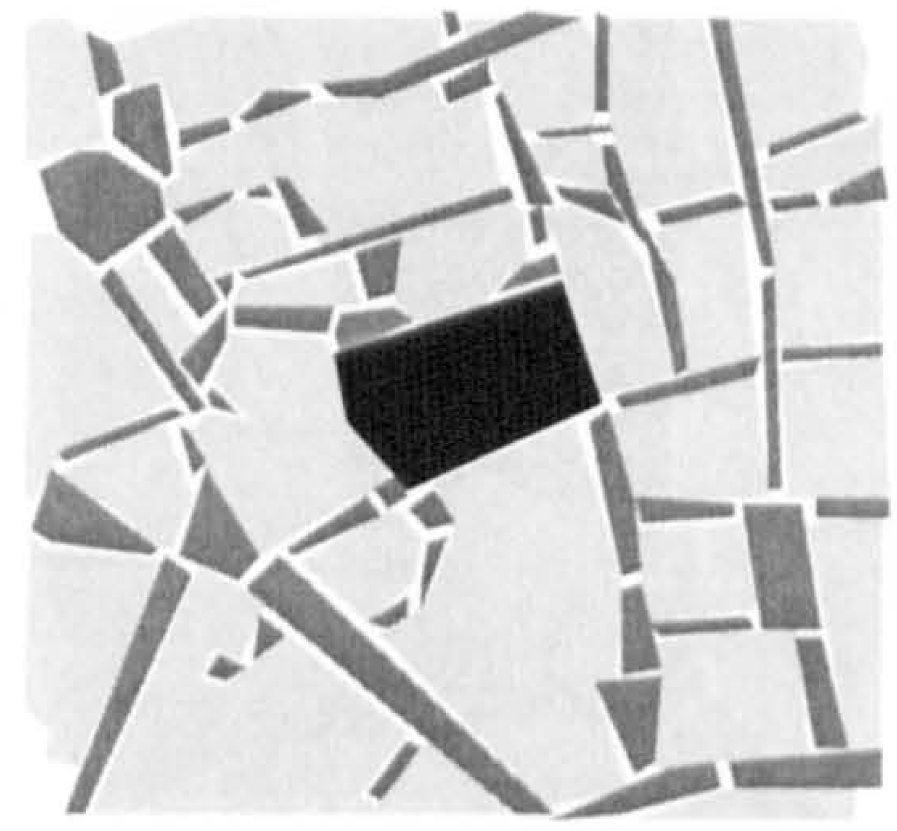


Fig. 3. Esslingen - Germany

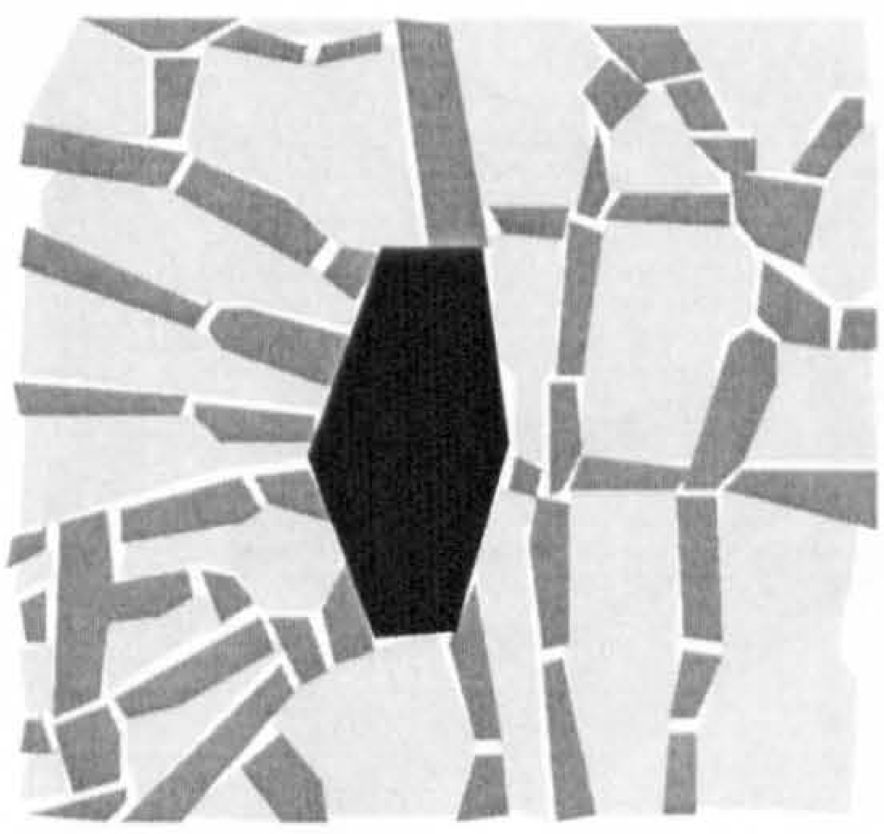


Fig. 4. Evora - Portugal

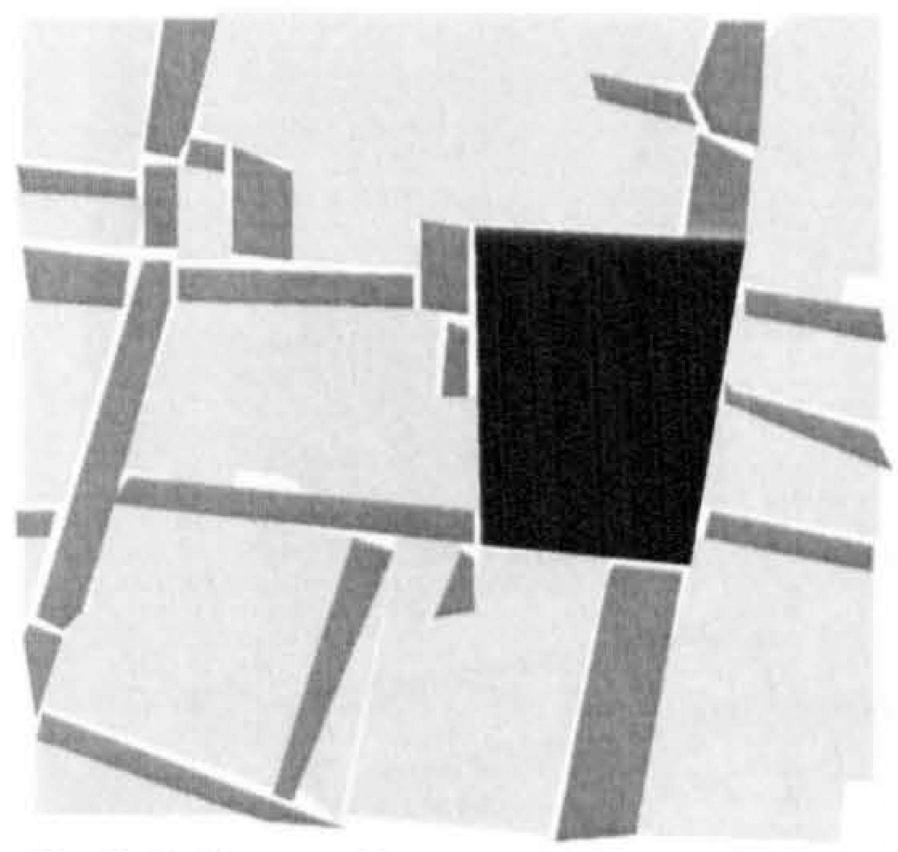


Fig. 5. Heilbronn - Germany

Fig. 6. Kempten - Germany

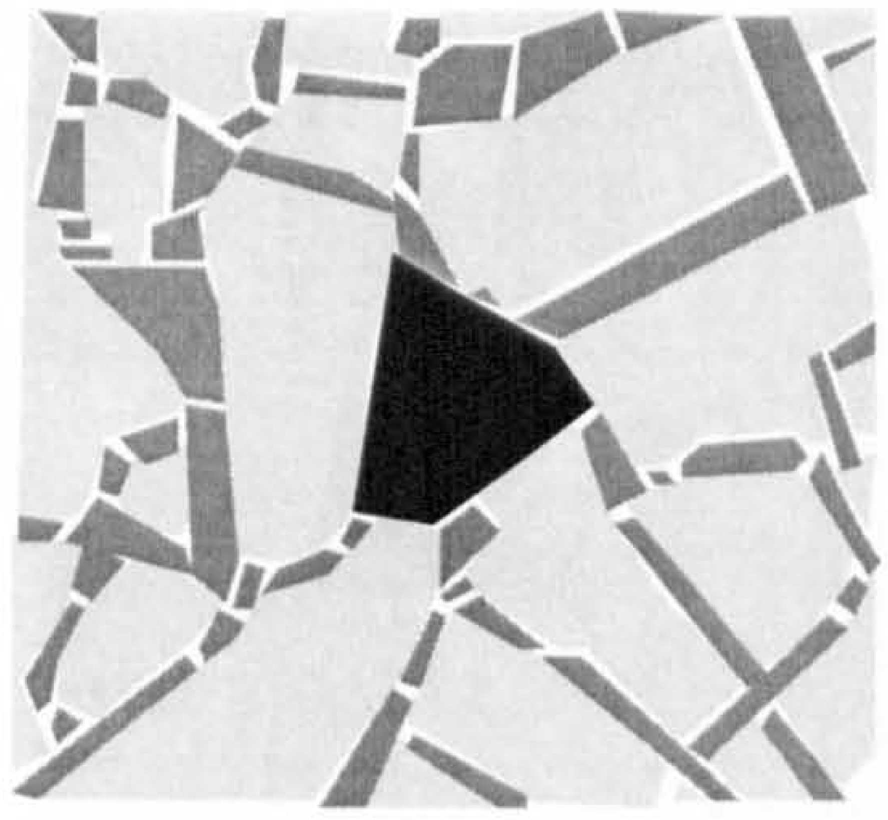


Fig. 7. Kutna Hora - Czech Republic

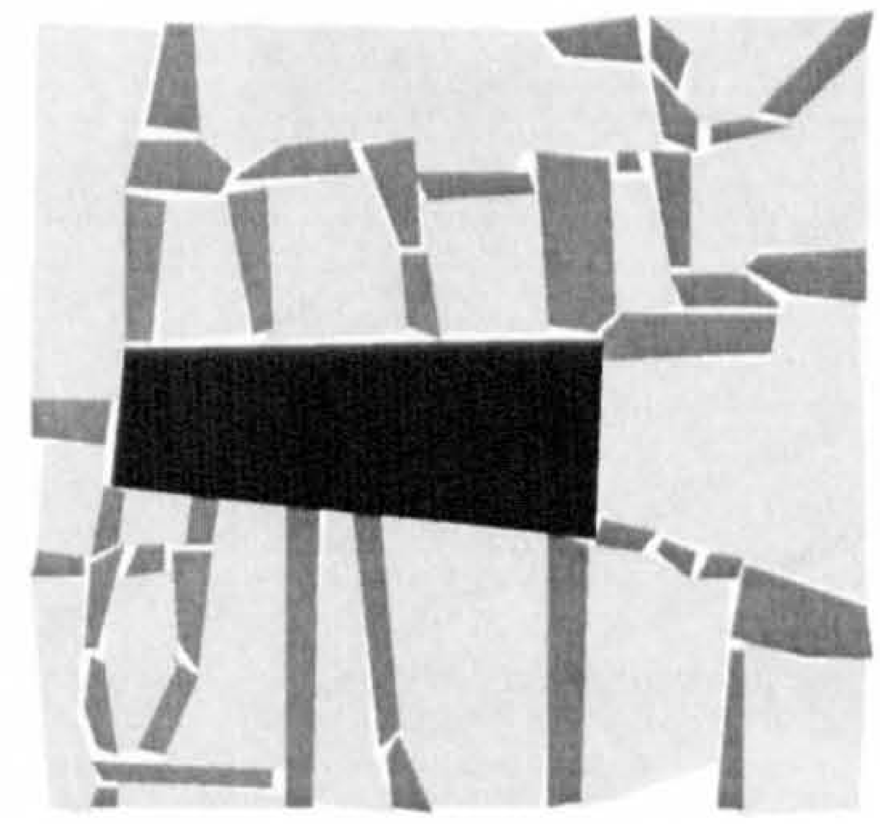


Fig. 8. Magdeburg - Germany

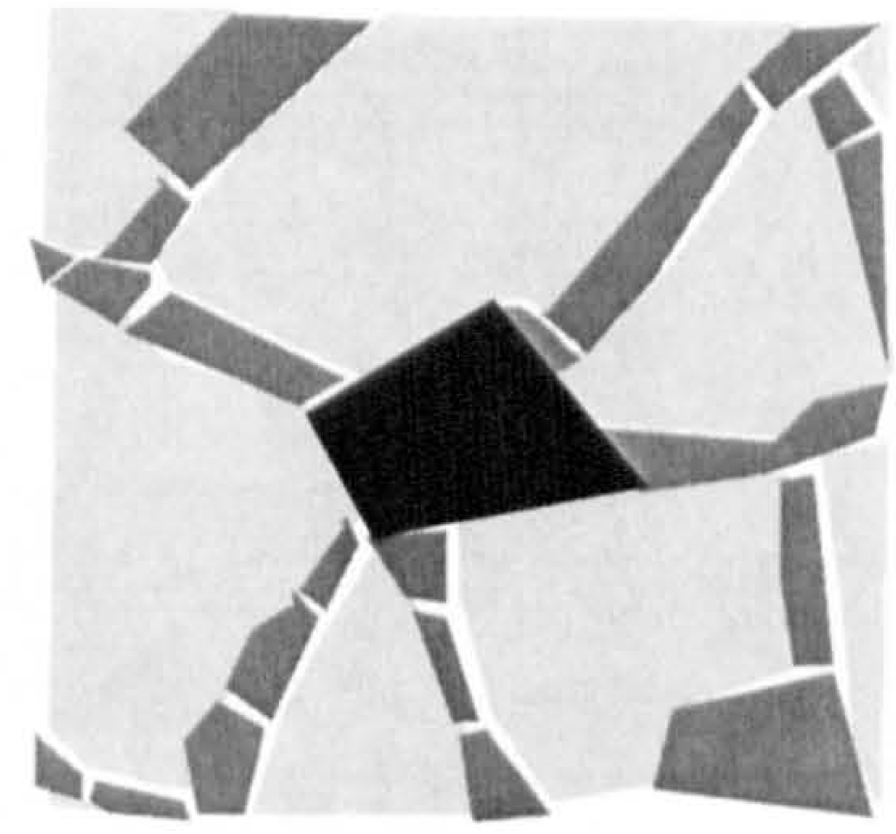


Fig. 9. Moguer - Spain

Plate 3.2. European towns convex break-up (2/3)

plans not in scale
for illustration only

convex break-up
main convex element
urban blocks

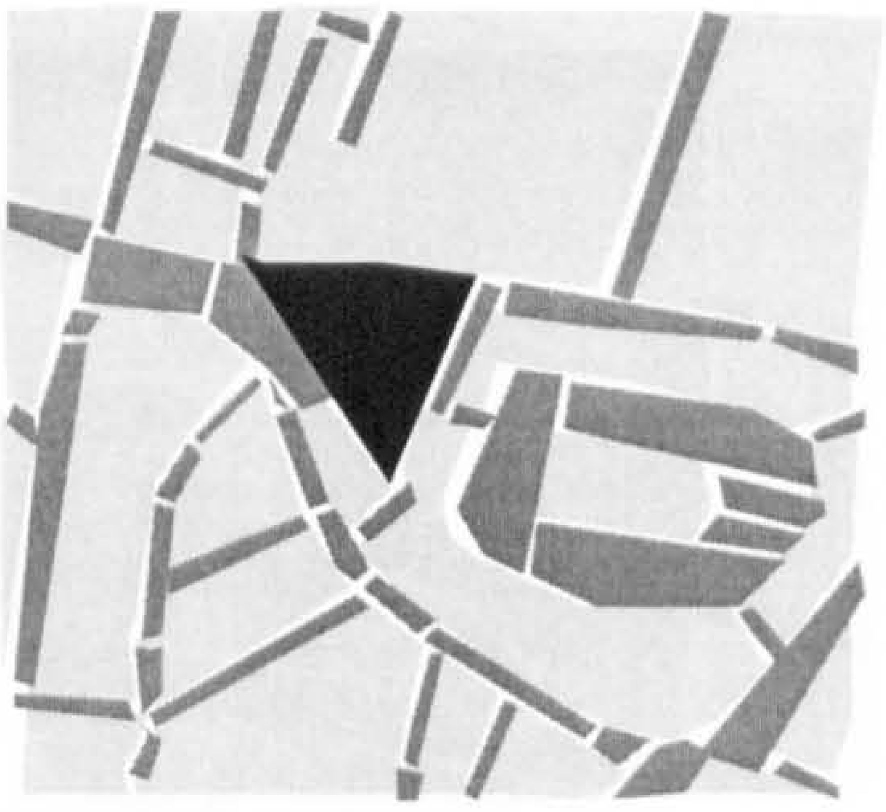


Fig. 10. Nijmegen - Netherlands

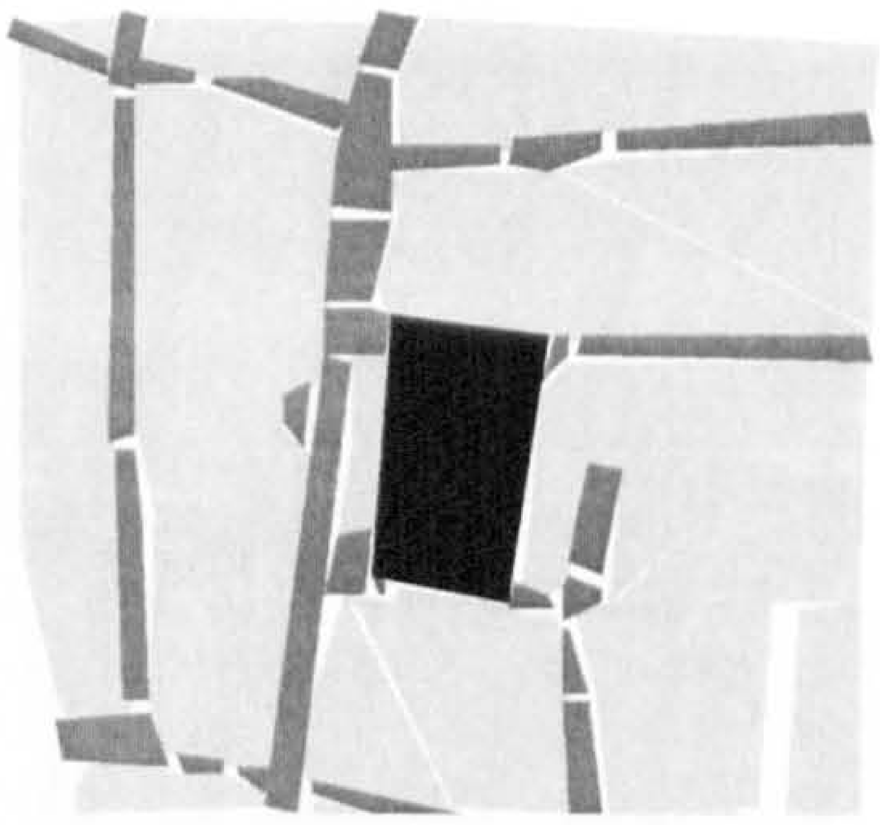


Fig. 11. Palencia - Spain

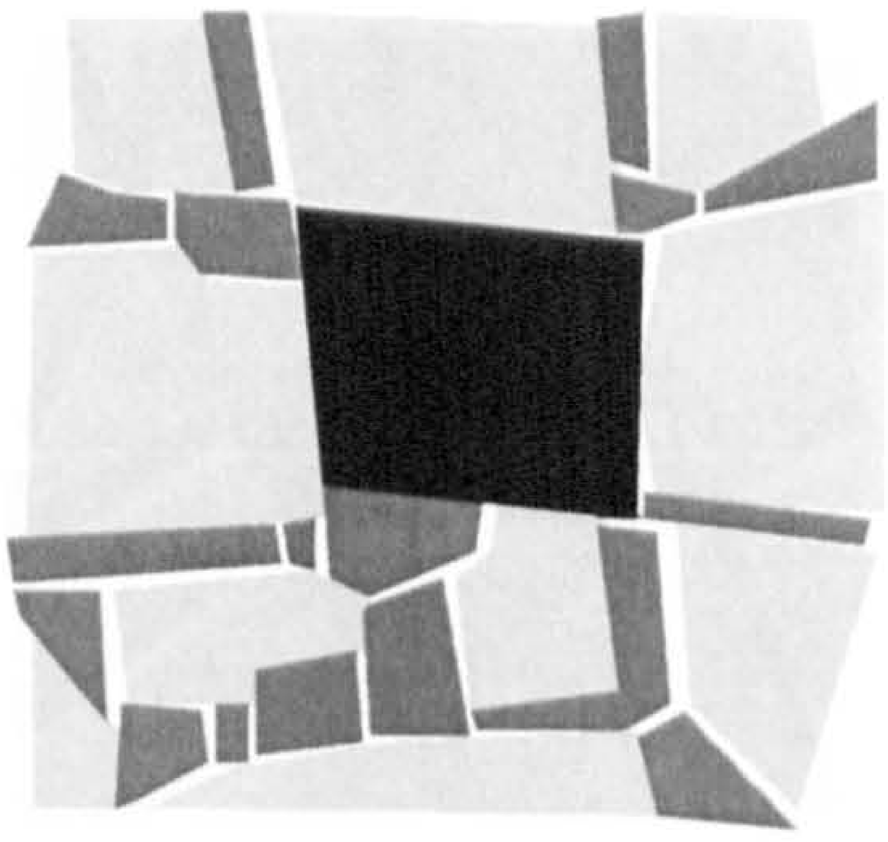


Fig. 12. Pest - Hungary

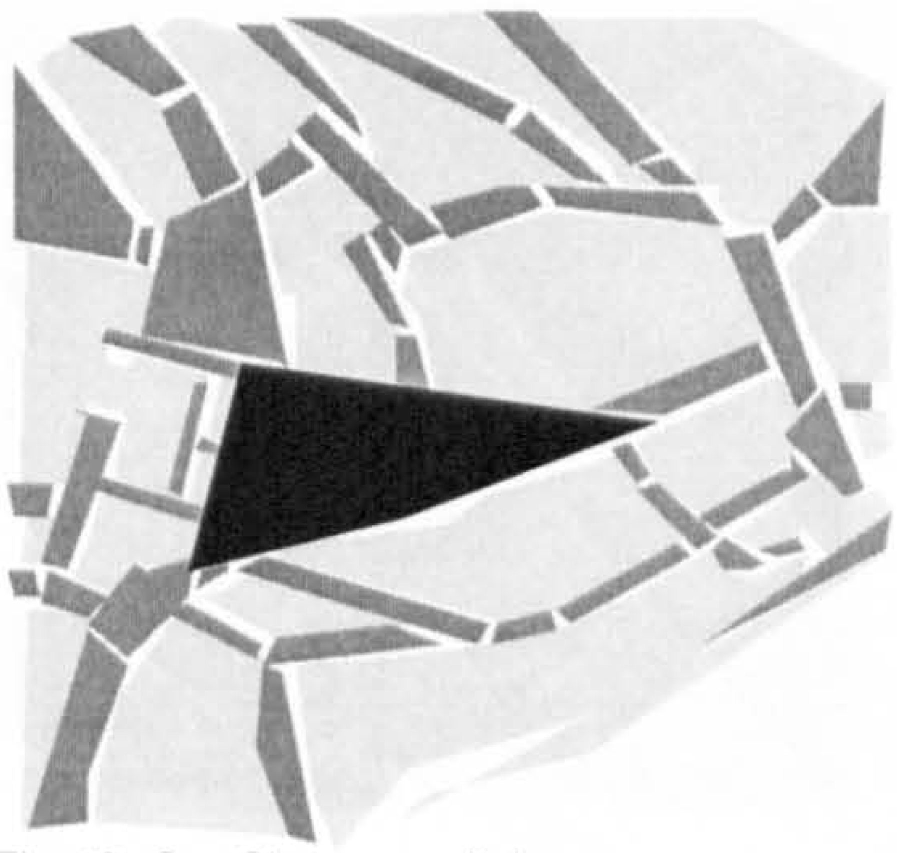


Fig. 13. San Gimignano - Italy

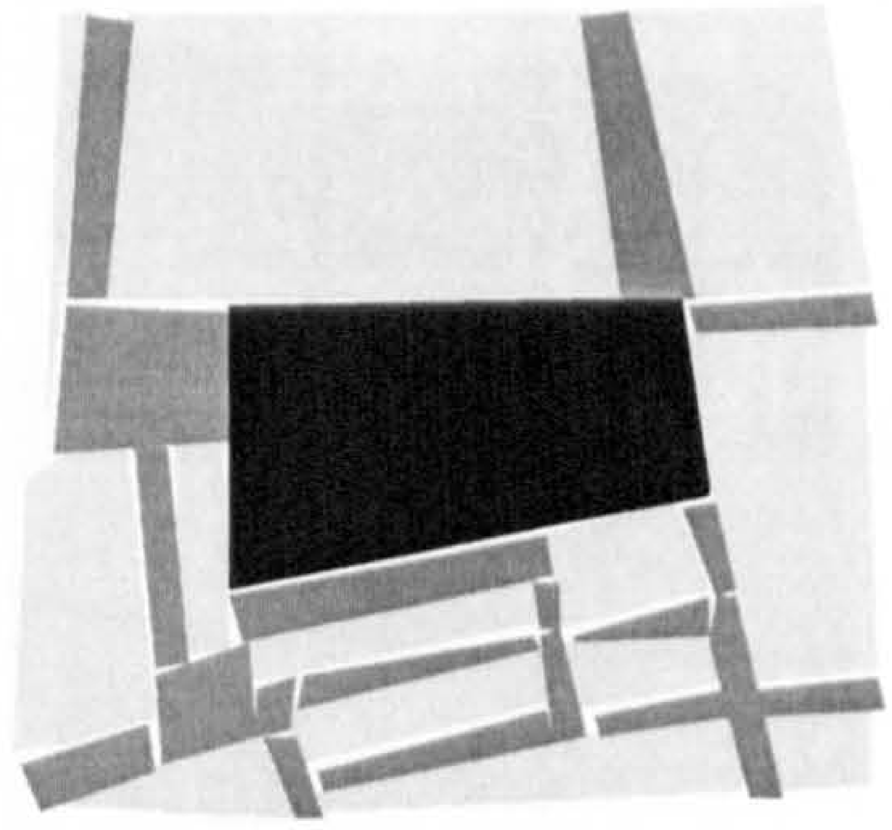


Fig. 14. Salisbury - U.K.

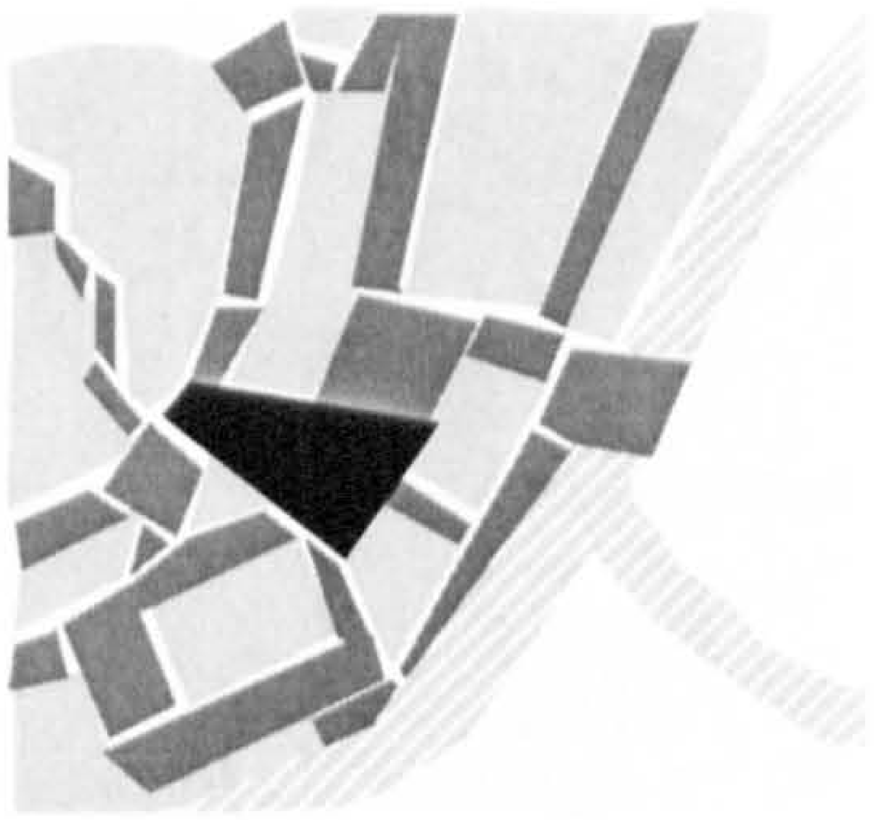


Fig. 15. Verdun- France

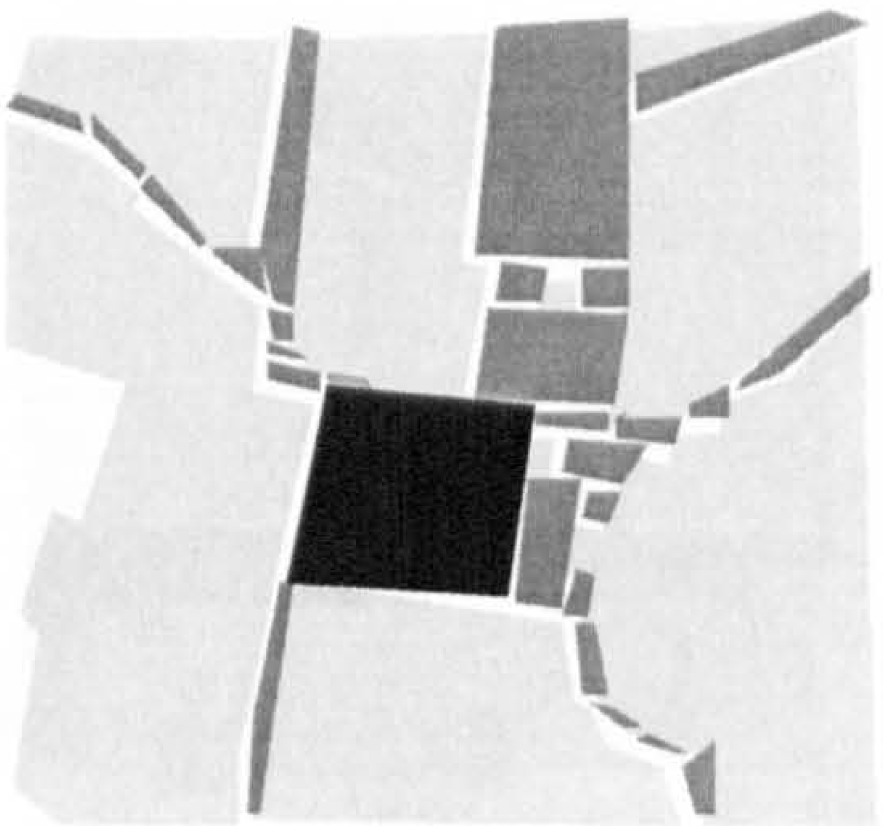


Fig. 16. Volkermarkt - Austria

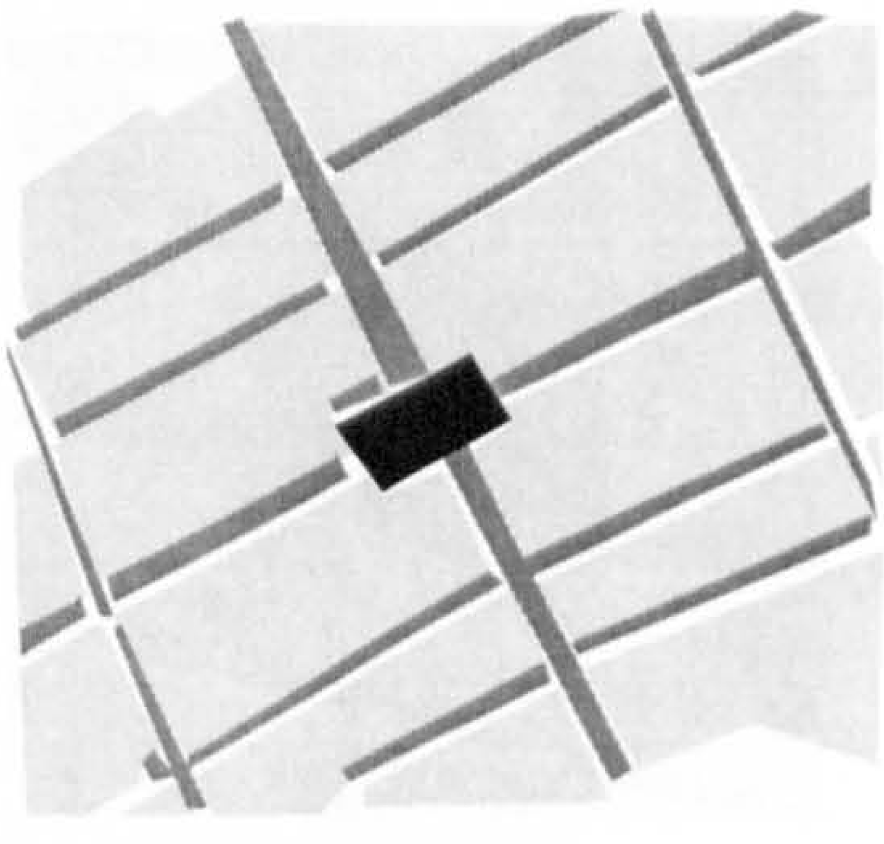


Fig. 17. Borgomanero - Italy

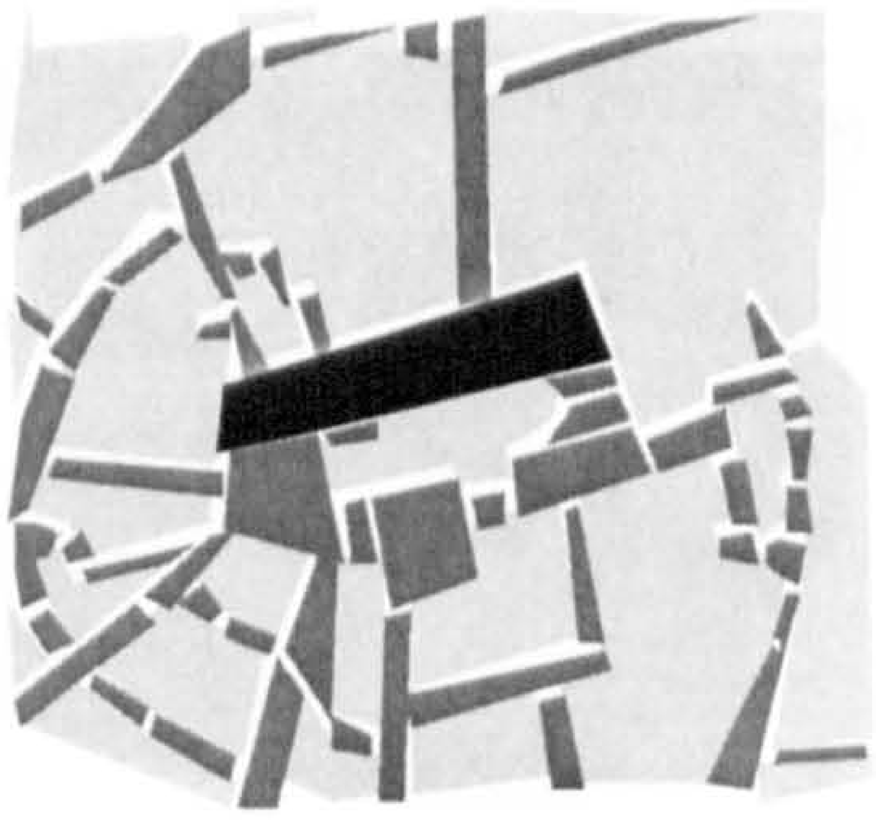


Fig. 18. Brive - France

Plate 3.2. European towns convex break-up (3/3)

plans not in scale
for illustration only

convex break-up
main convex element
urban blocks

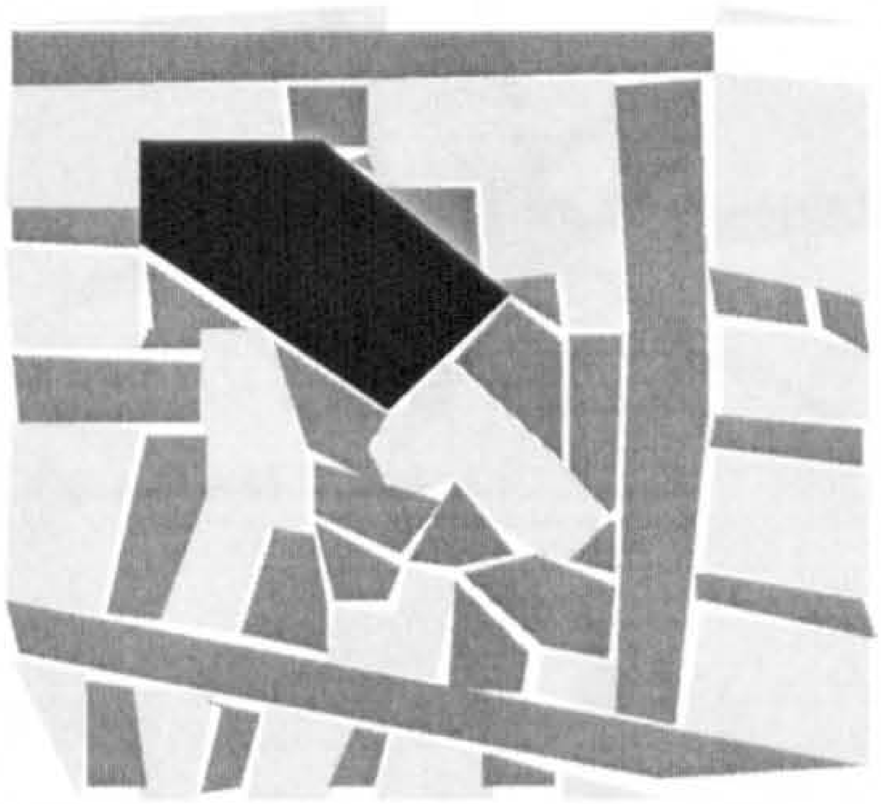


Fig. 19. Castellon de la Plana- Spain

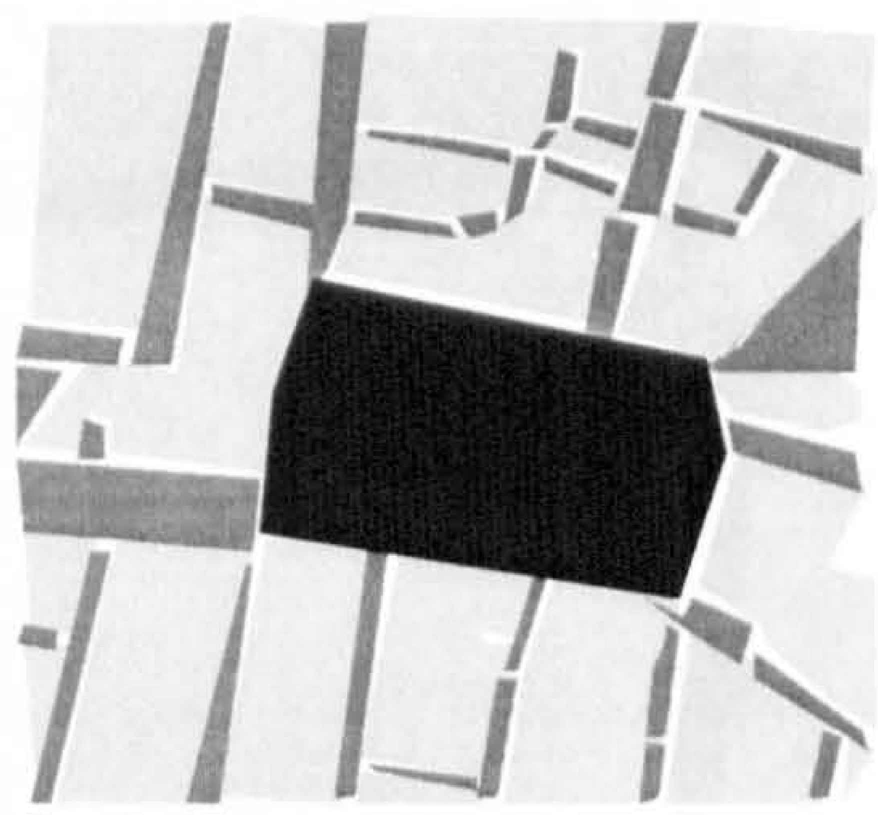


Fig. 20. Groningen- Netherlands

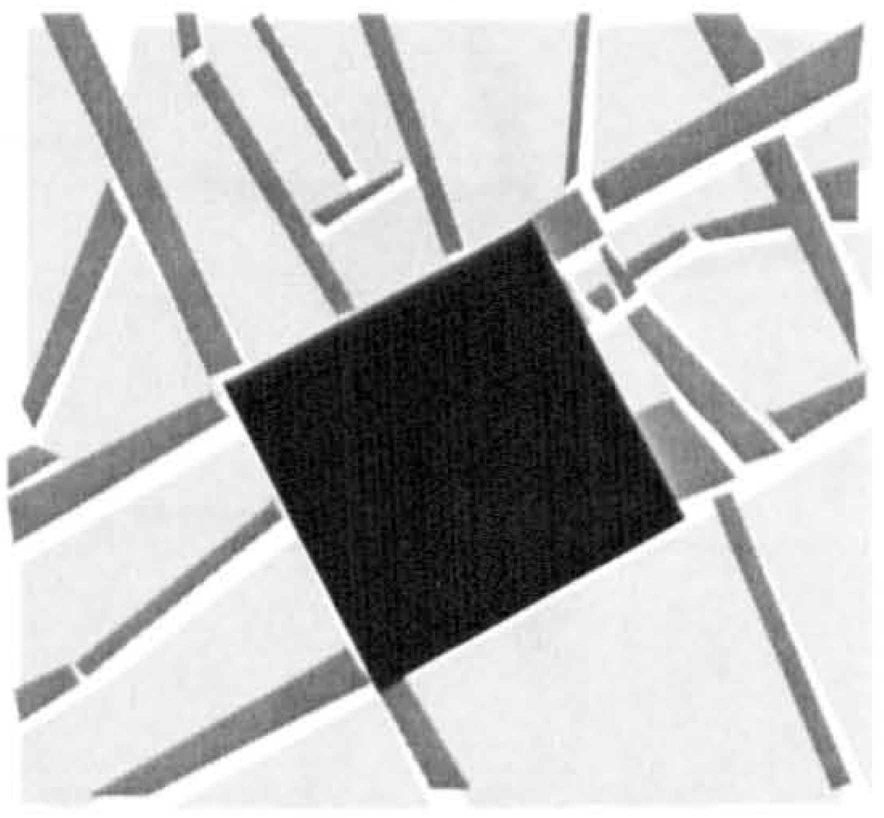


Fig. 21. Gyor - Hungary

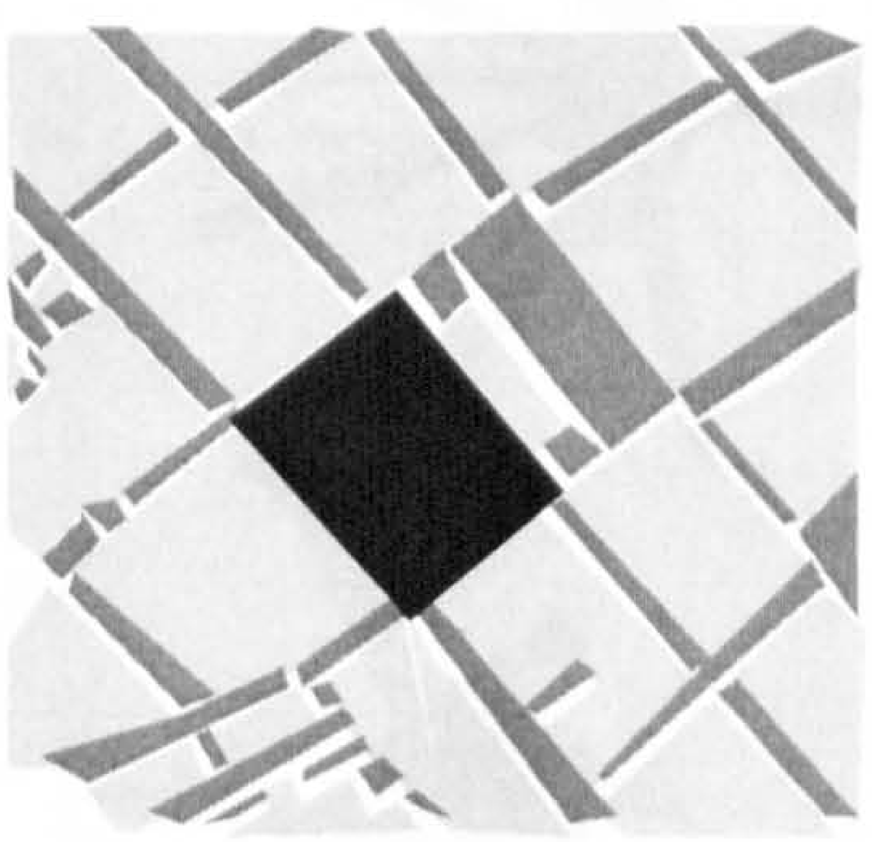


Fig. 22. Kalisz - Poland

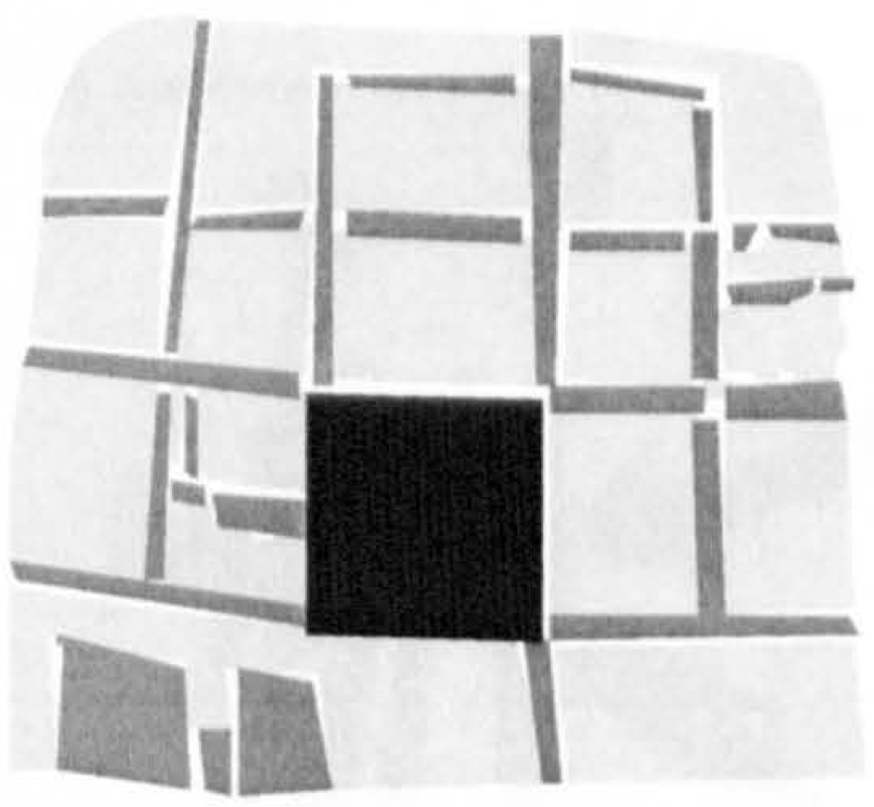


Fig. 23. Klatovy - Czech Republic

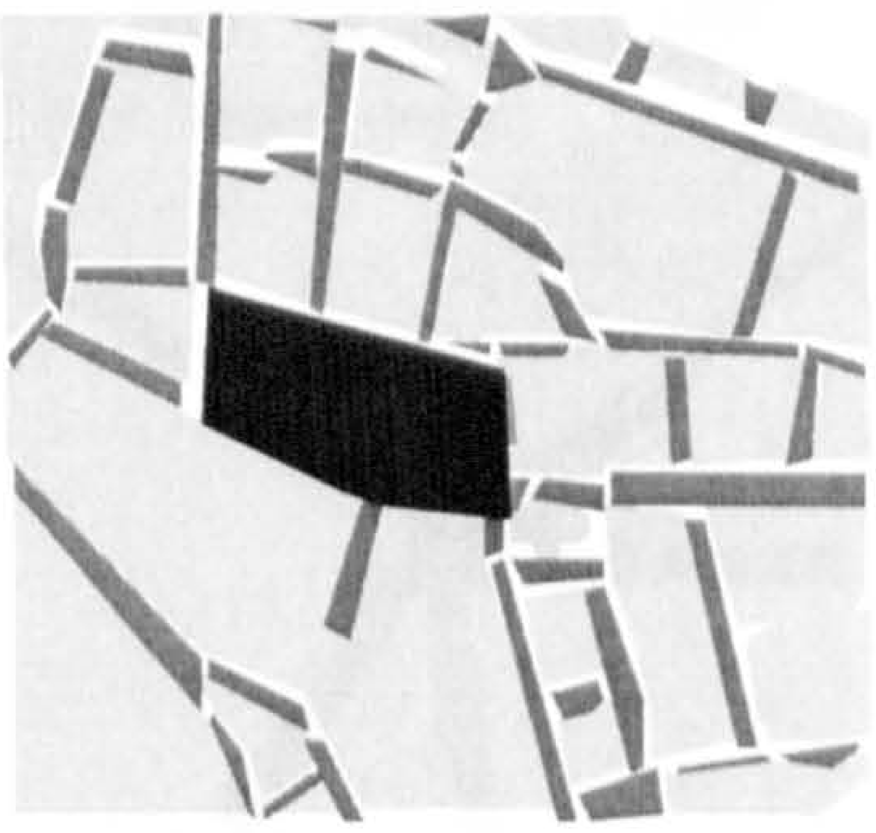


Fig. 24. Litomerice - Czech Republic

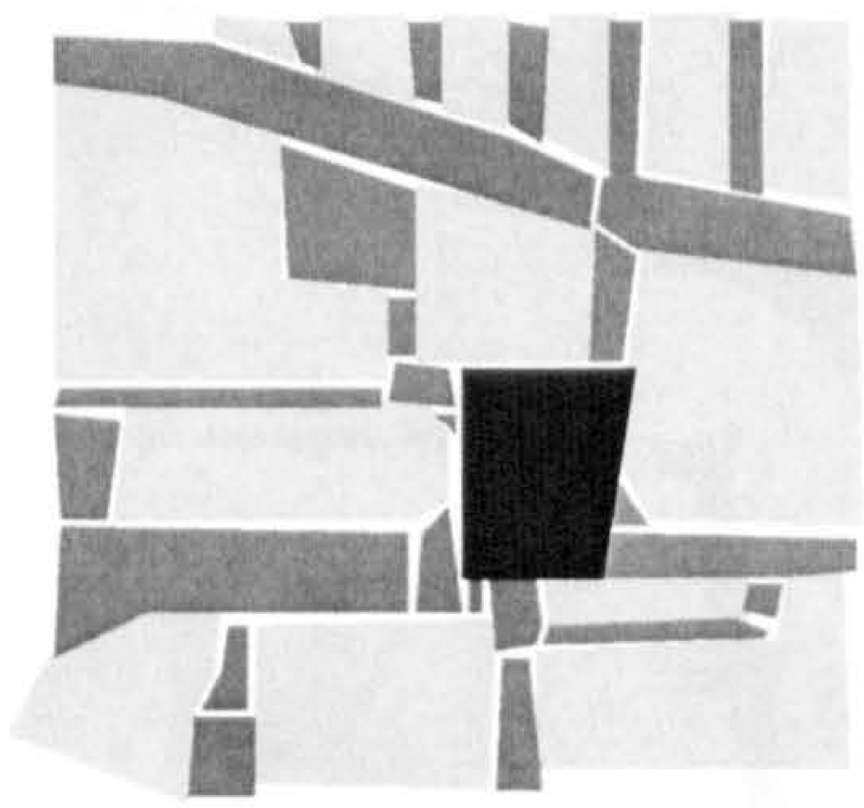


Fig. 25. Modena - Italy

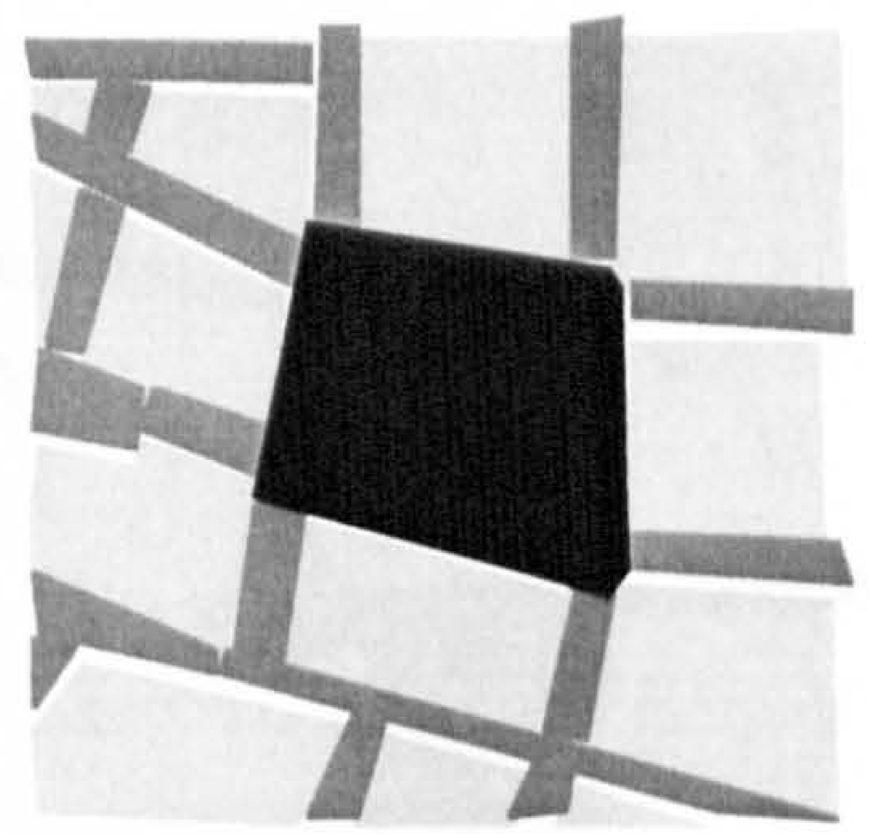


Fig. 26 Montauban- France

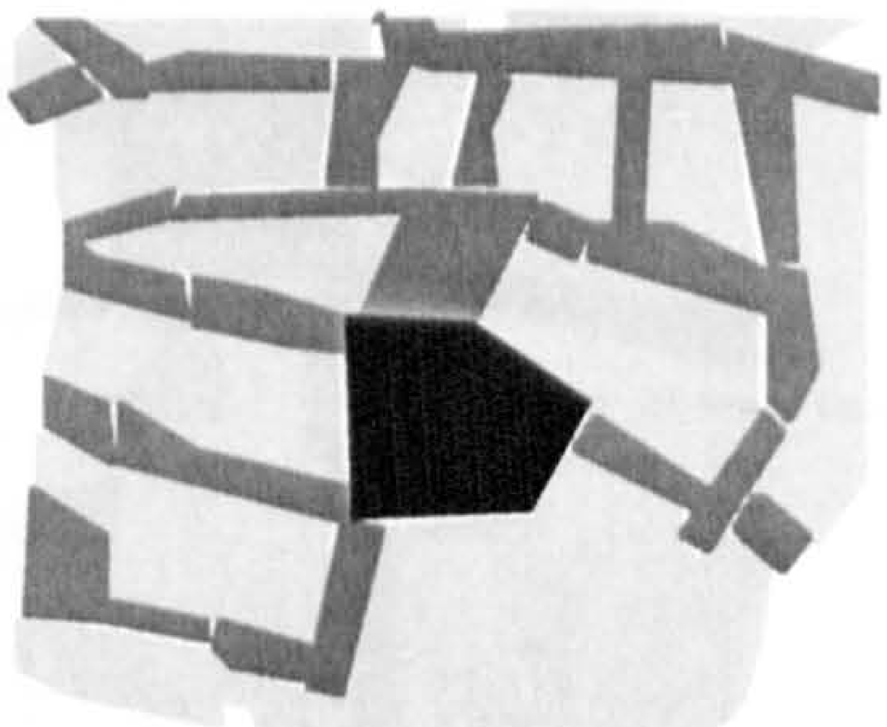


Fig. 27. Portalegre - Portugal

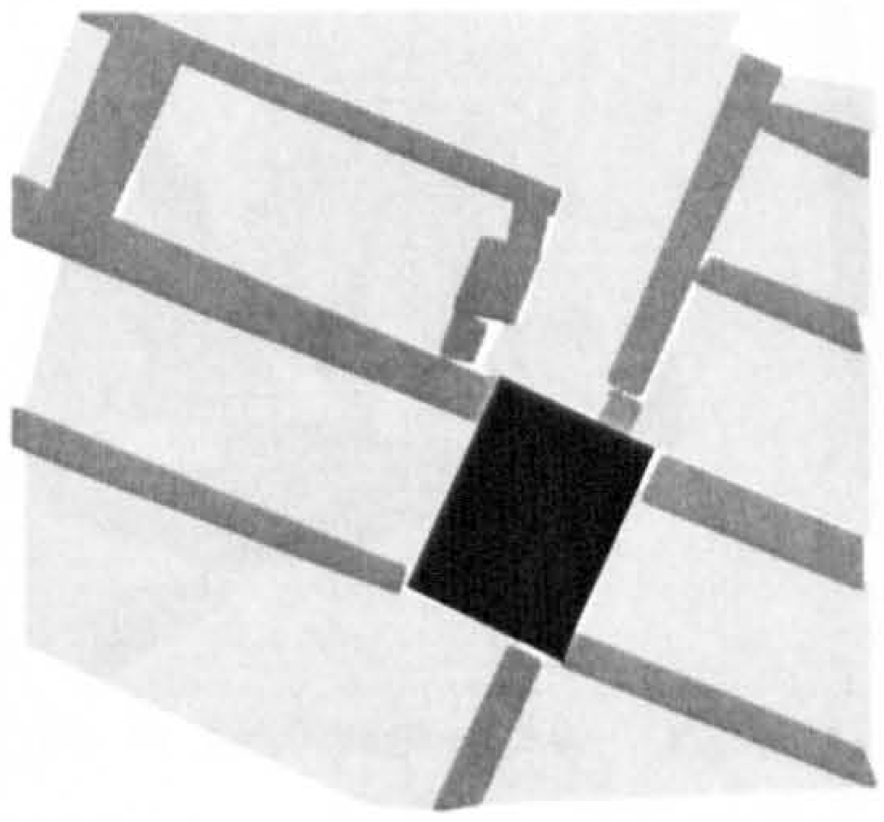


Fig. 28. Scarperia - Italy

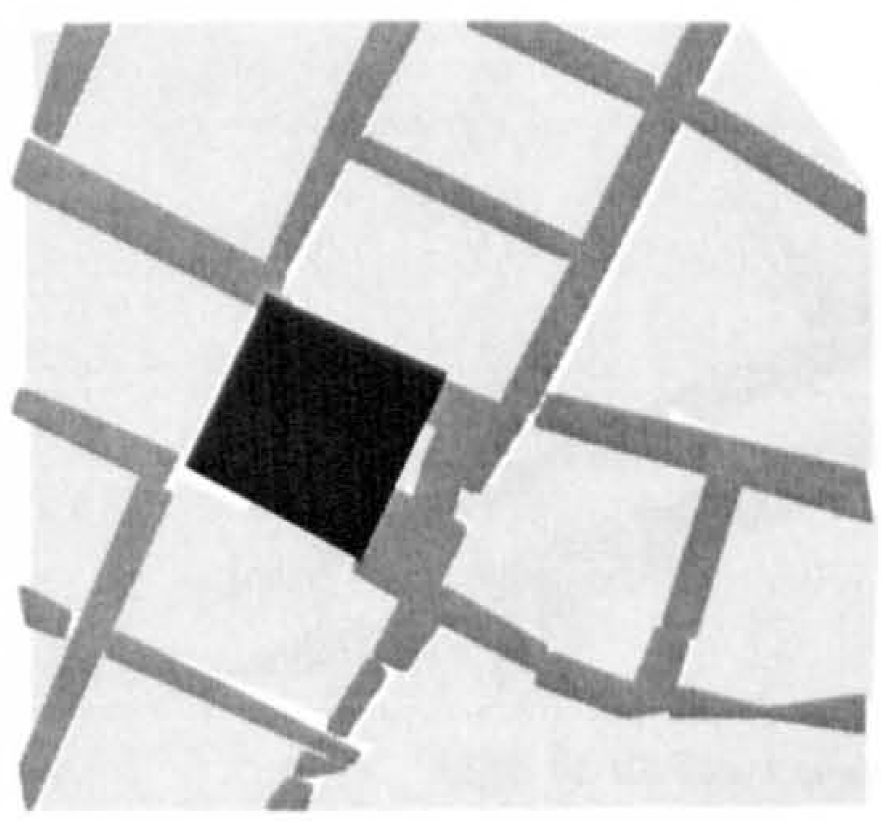


Fig. 29. Wielun - Poland

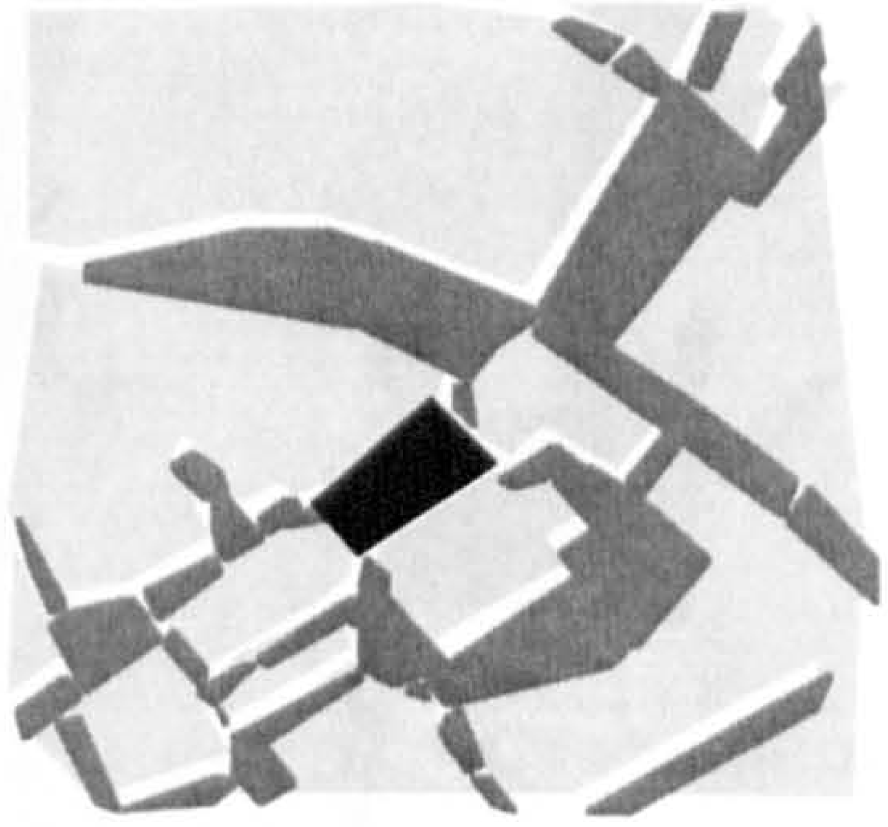


Fig. 30. Wolfsberg - Austria

Plate 3.3. Main convex element - convex isovist (1/2)

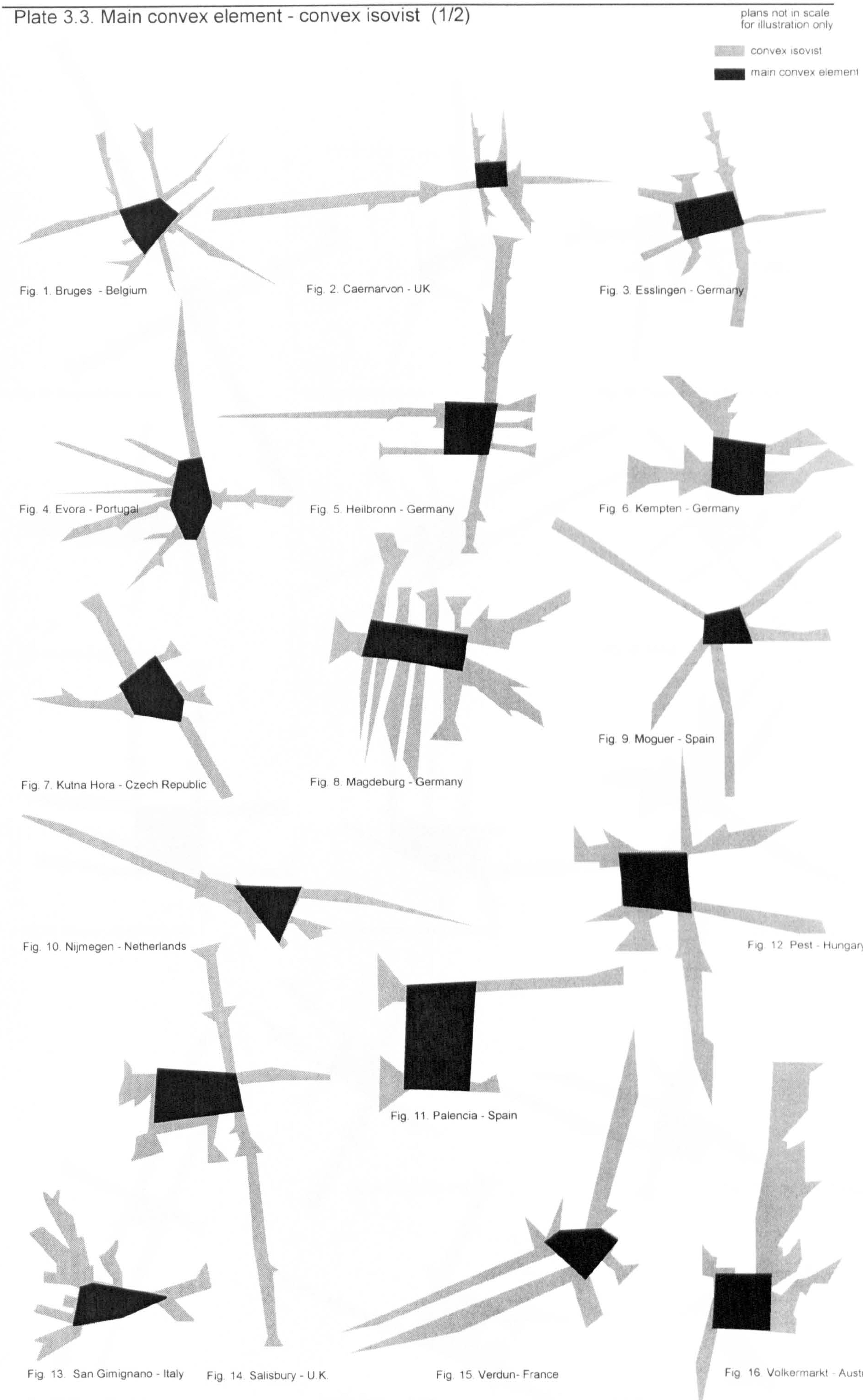


Fig. 1. Bruges - Belgium

Fig. 2. Caernarvon - UK

Fig. 3. Esslingen - Germany

Fig. 4. Evora - Portugal

Fig. 5. Heilbronn - Germany

Fig. 6. Kempten - Germany

Fig. 7. Kutna Hora - Czech Republic

Fig. 8. Magdeburg - Germany

Fig. 9. Moguer - Spain

Fig. 10. Nijmegen - Netherlands

Fig. 11. Palencia - Spain

Fig. 12. Pest - Hungary

Fig. 13. San Gimignano - Italy

Fig. 14. Salisbury - U.K.

Fig. 15. Verdun- France

Fig. 16. Volkermarkt - Austri

Plate 3.3: Main convex element - convex isovist (2/2)

plans not in scale
for illustration only

convex isovist

main convex element

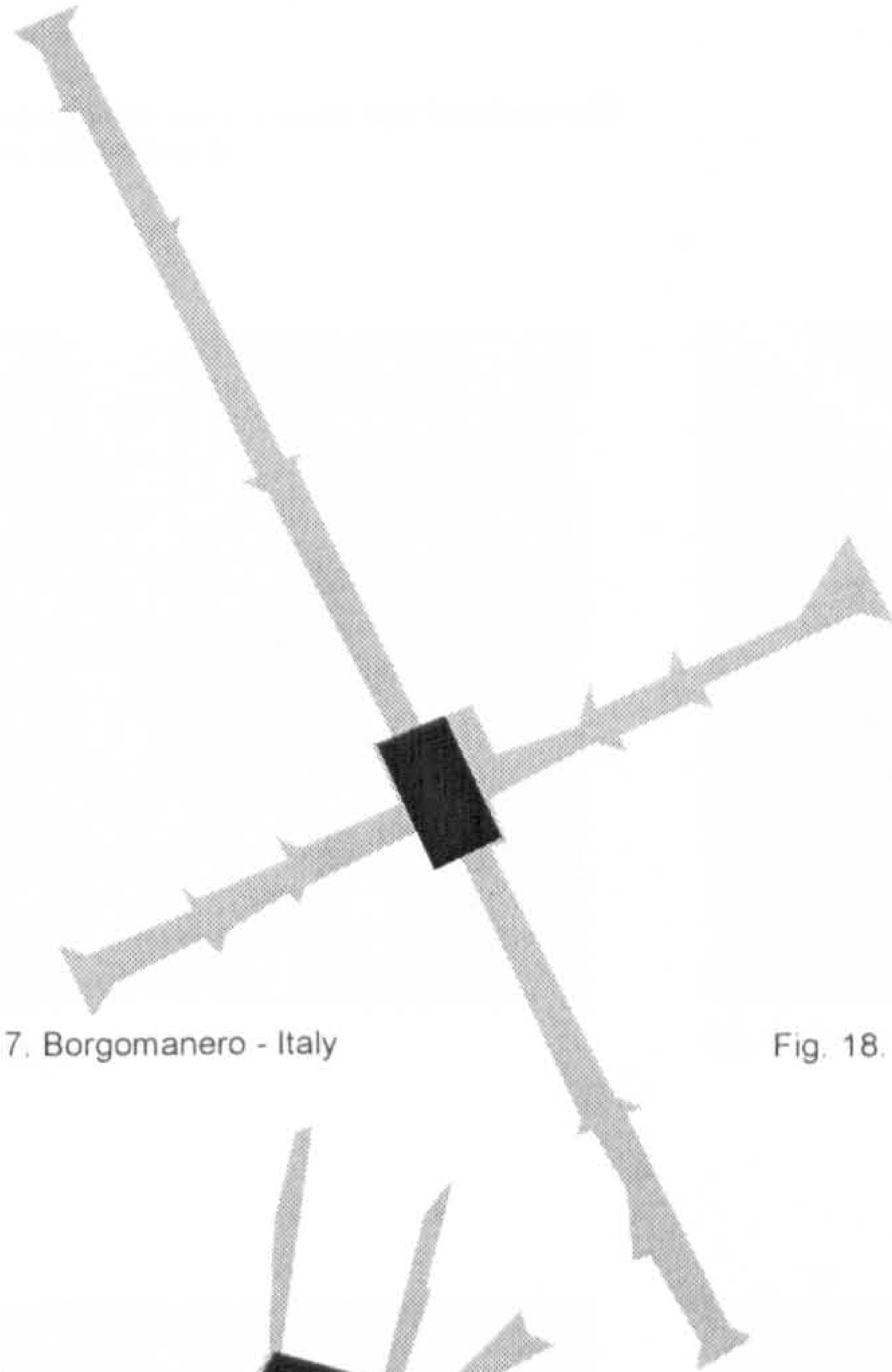


Fig. 17. Borgomanero - Italy

Fig. 18. Brive - France

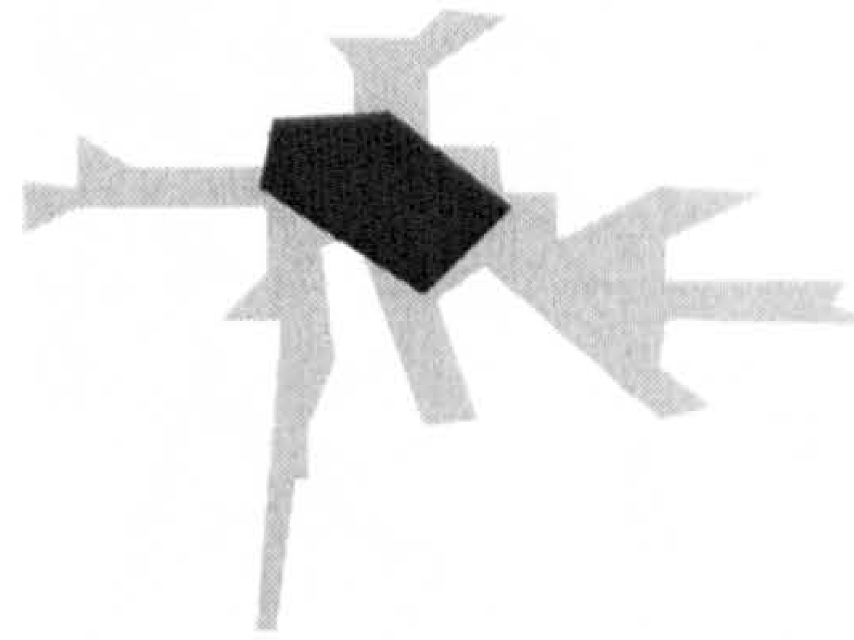


Fig. 19. Castellon de la Plana- Spain

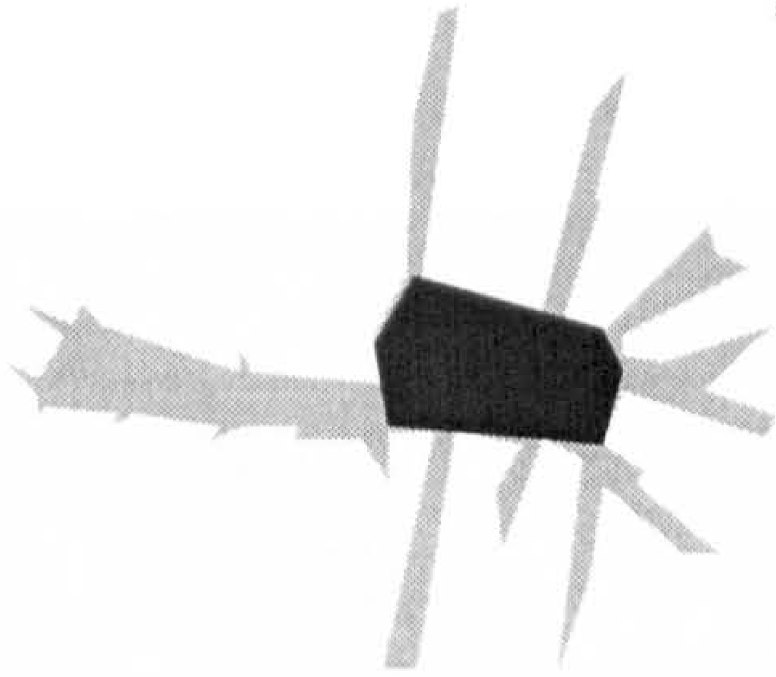


Fig. 20. Groningen- Netherlands

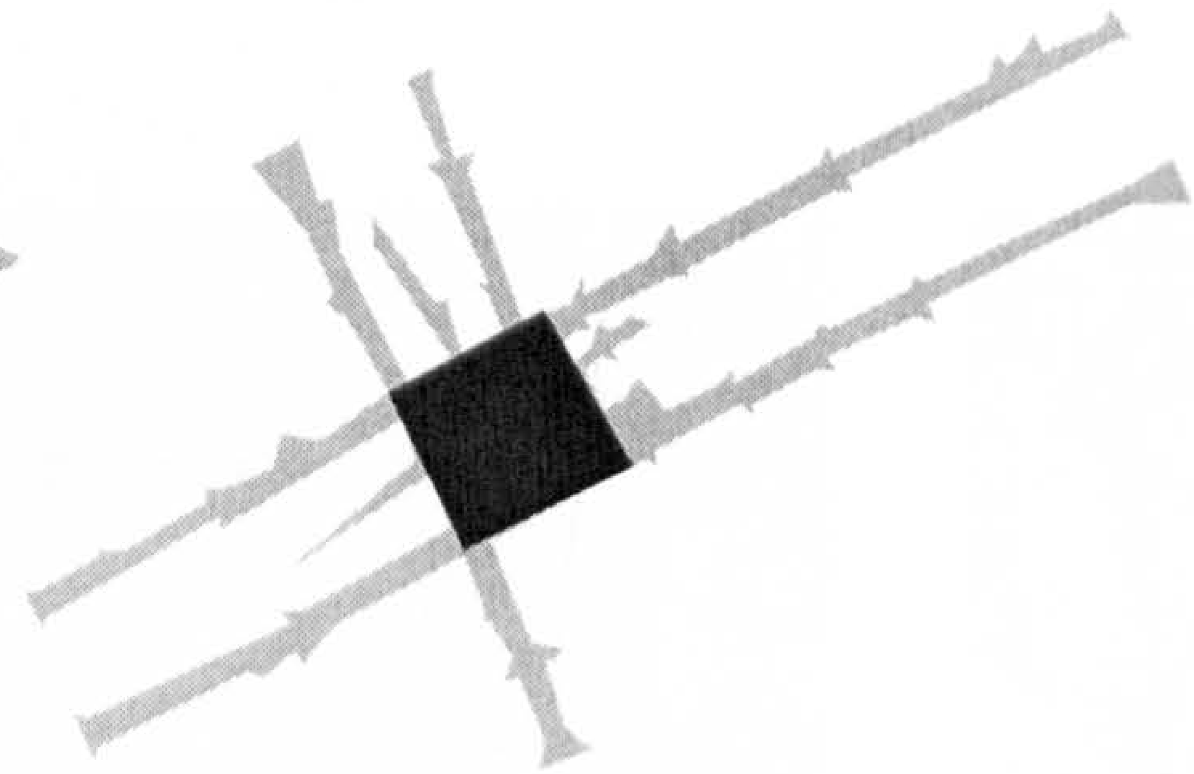


Fig. 21. Gyor - Hungary

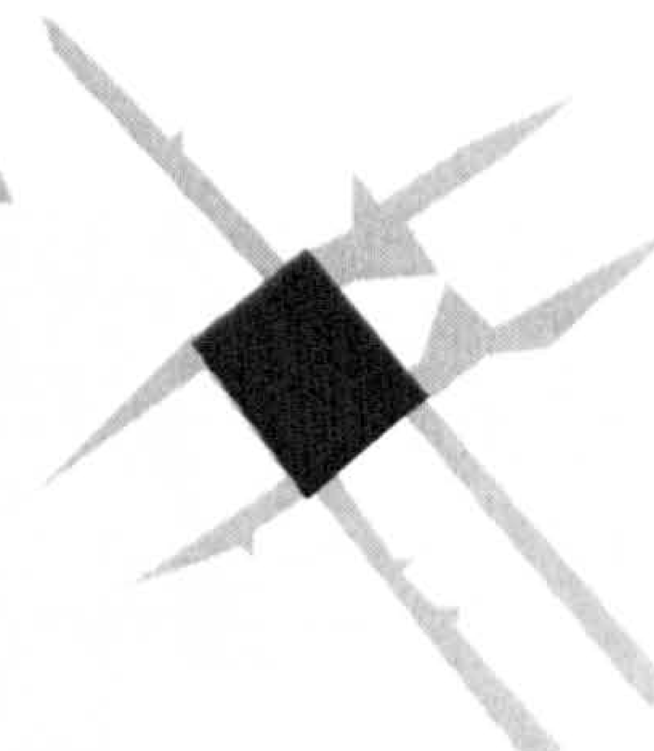


Fig. 22. Kalisz - Poland

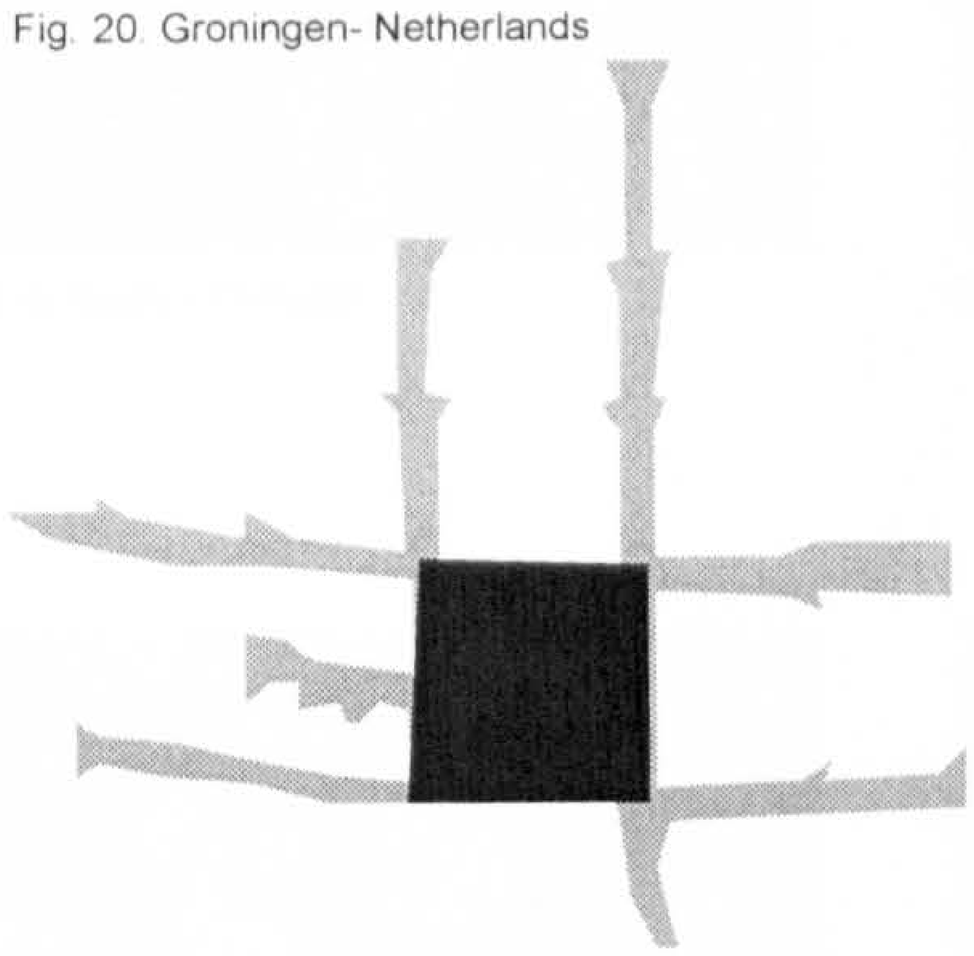


Fig. 23. Klatovy - Czech Republic

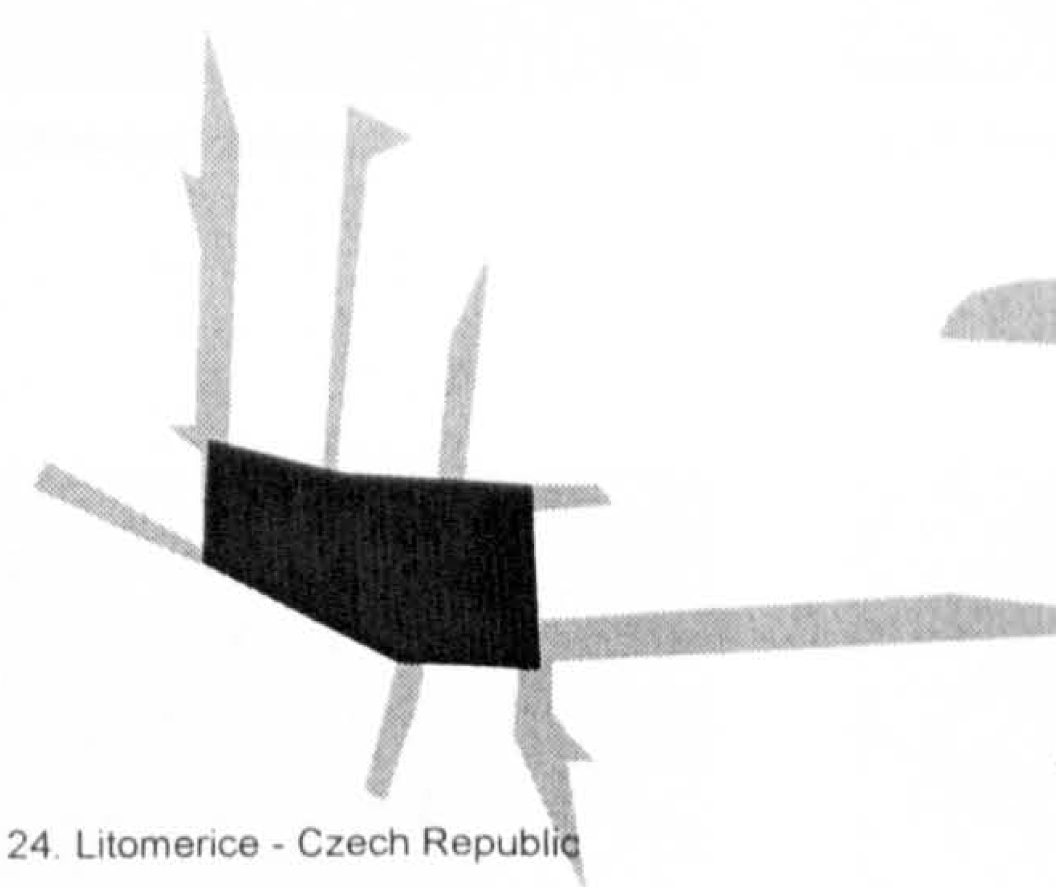


Fig. 24. Litomerice - Czech Republic

Fig. 25. Modena - Italy

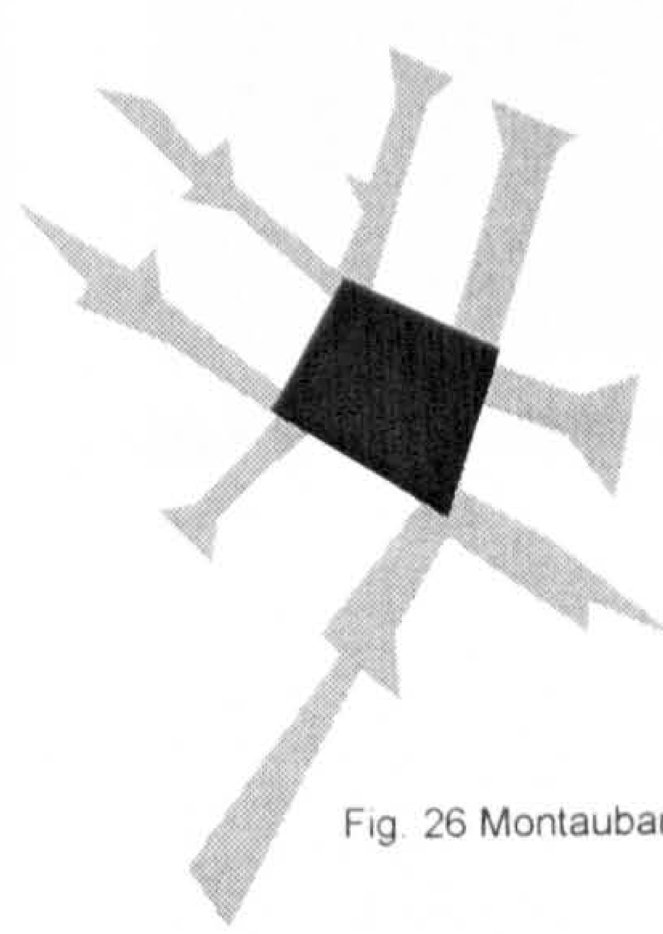


Fig. 26 Montauban- France

Fig. 27. Portalegre - Portugal

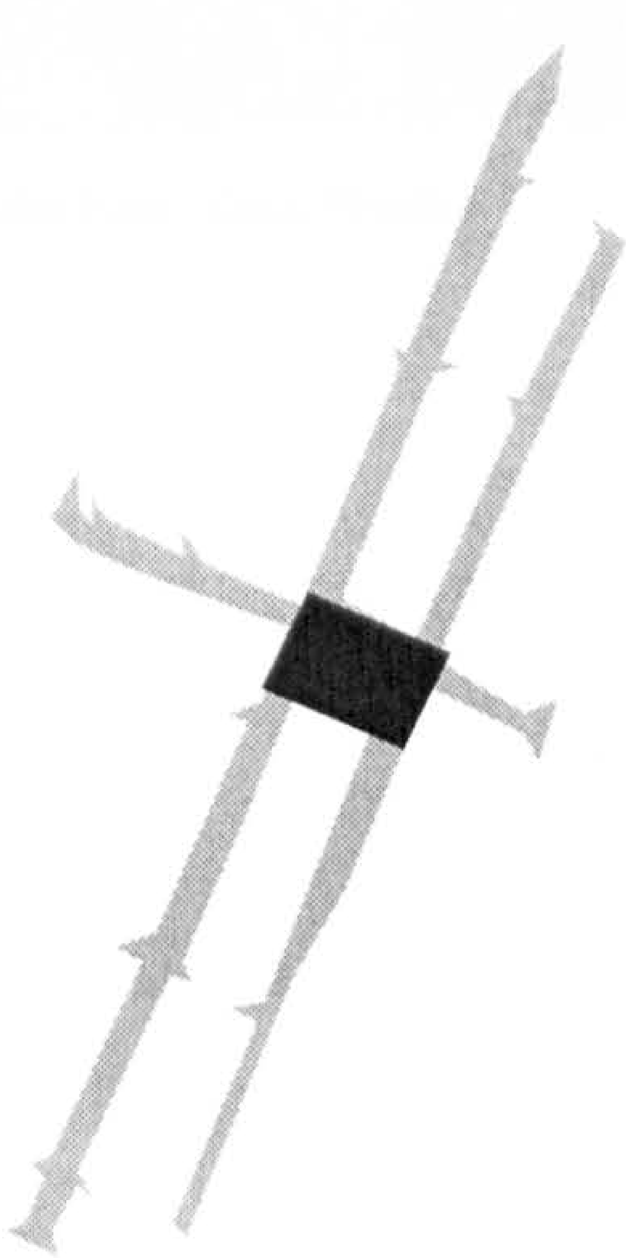


Fig. 28. Scarperia - Italy

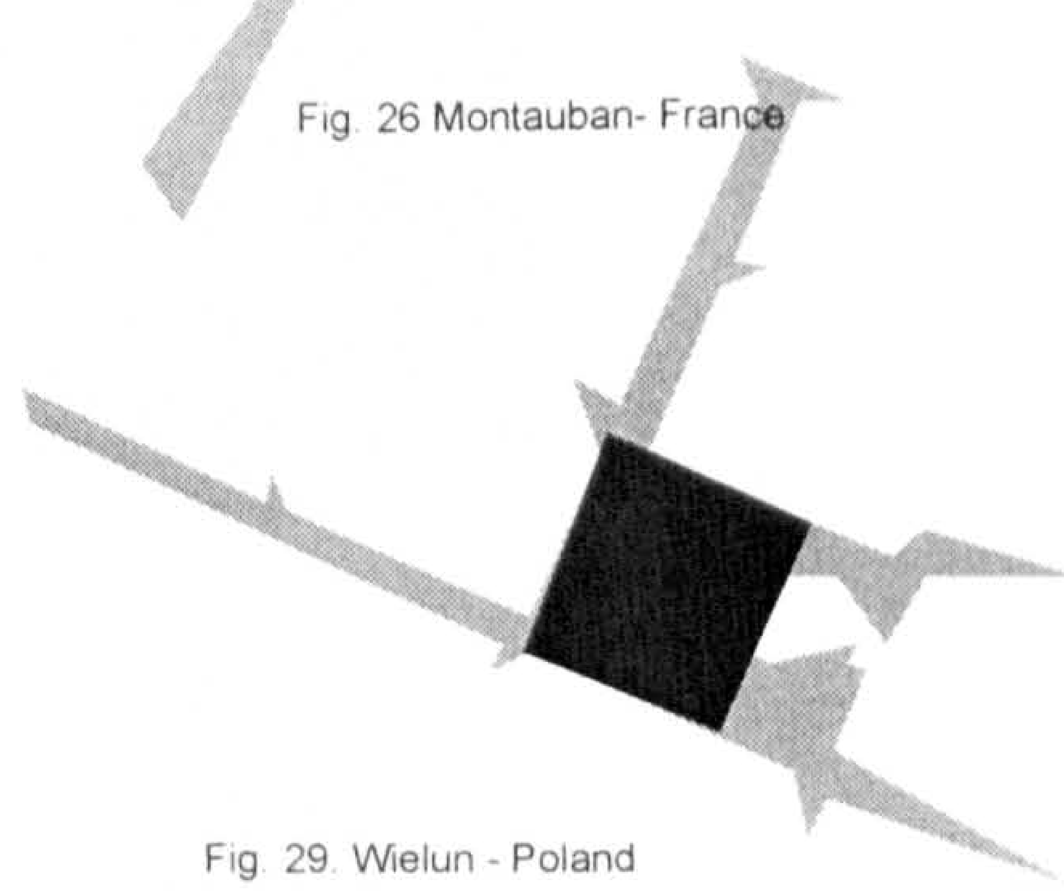


Fig. 29. Wielun - Poland

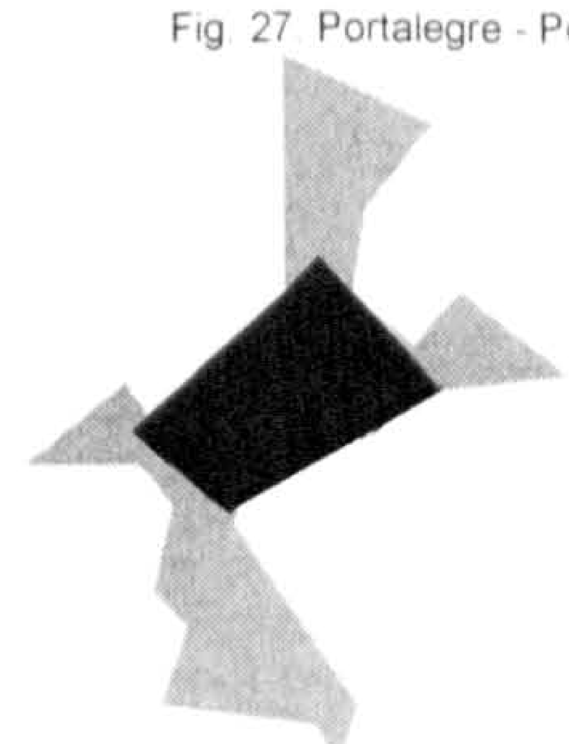


Fig. 30. Wolfsberg - Austria

Plate 3.4. Main convex element - interfacing axial lines (1/3)

plans not in scale
for illustration only

the axial lines shown are the ones that interface with main convex element only

convergent axial line
transverse axial line
peripheric axial line

main convex element
urban blocks
open space

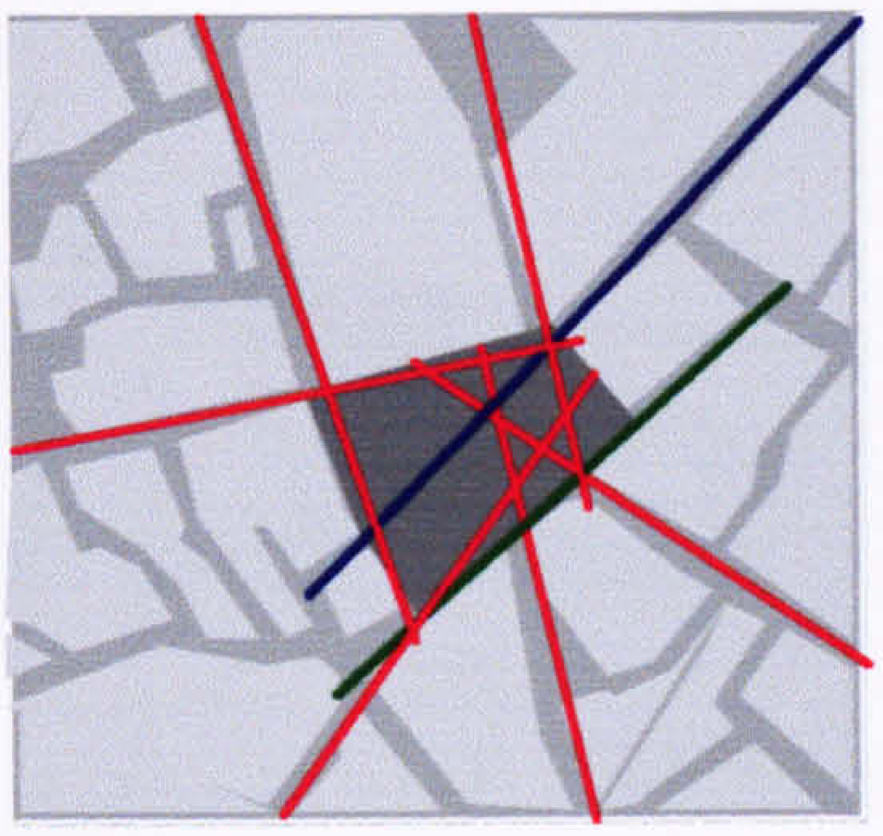


Fig. 1. Bruges - Belgium

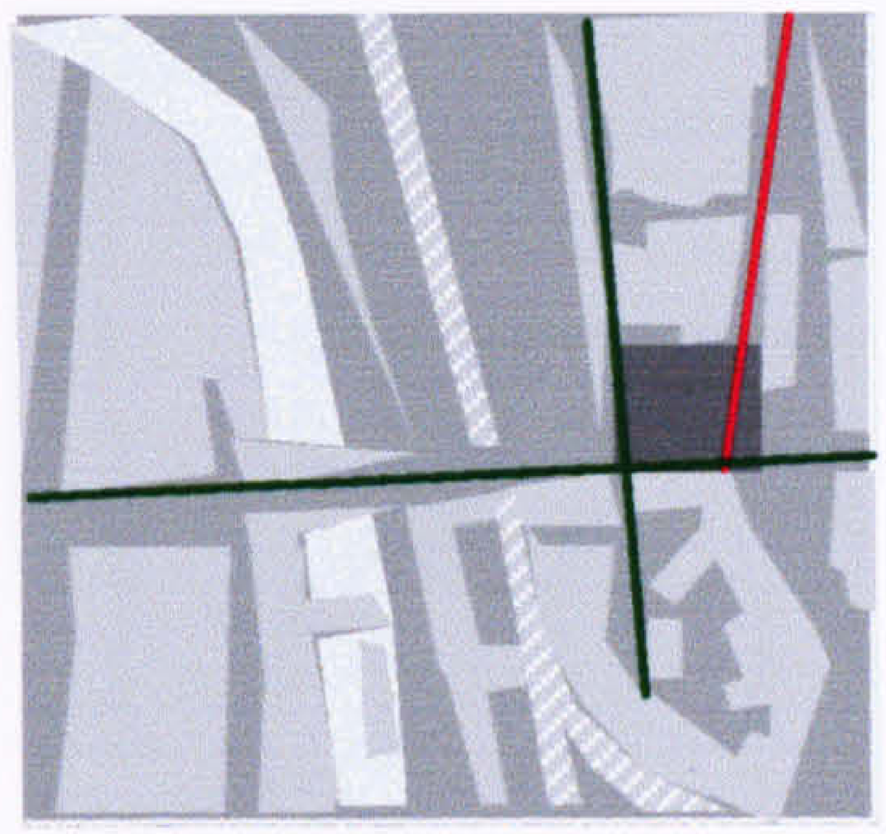


Fig. 2. Caernarvon - UK

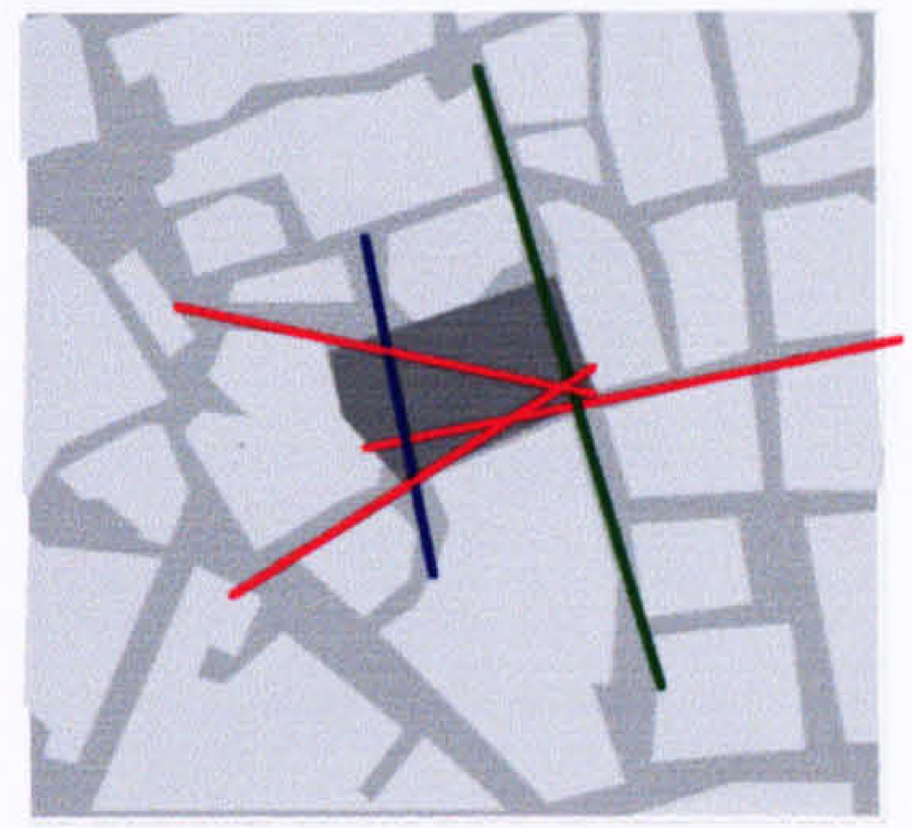


Fig. 3. Esslingen - Germany

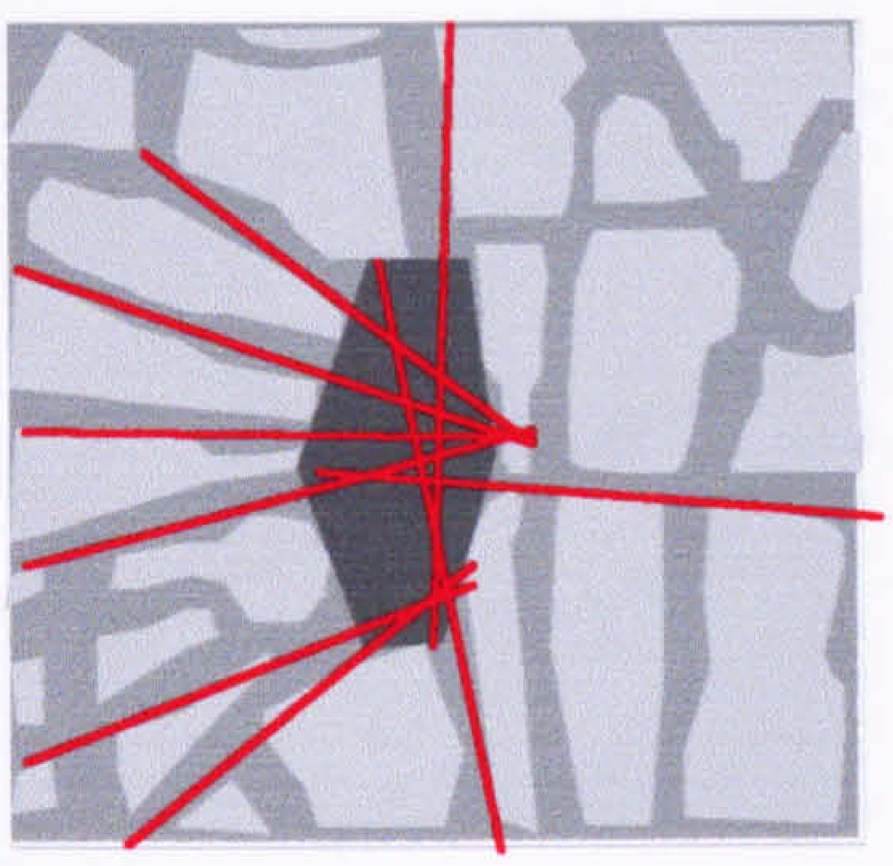


Fig. 4. Evora - Portugal

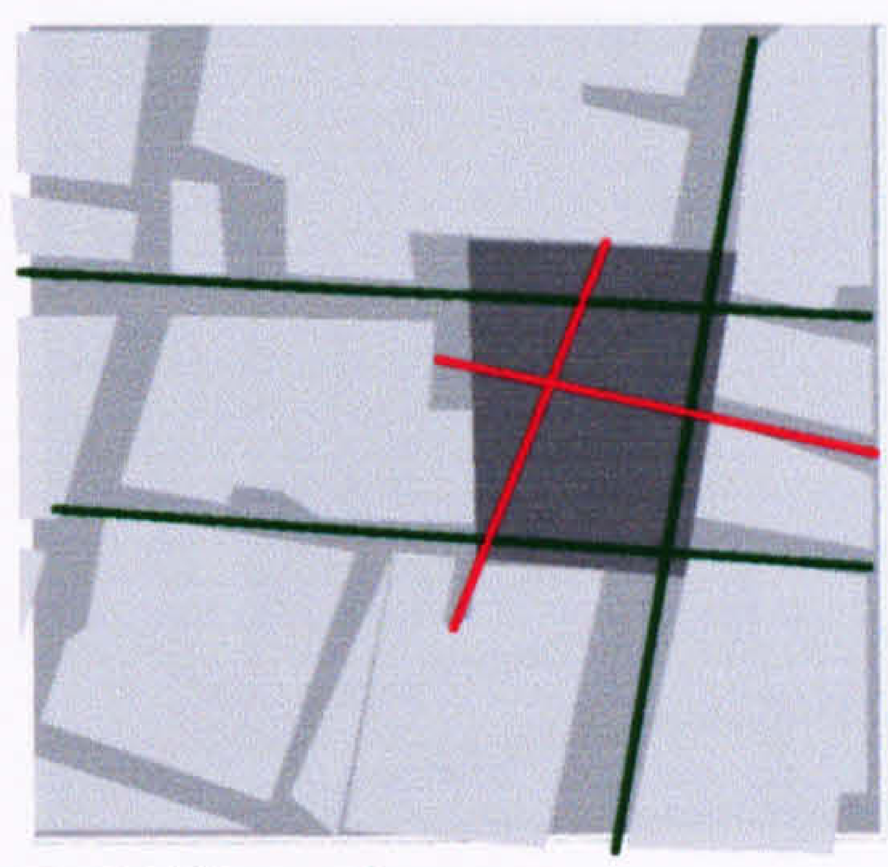


Fig. 5. Heilbronn - Germany

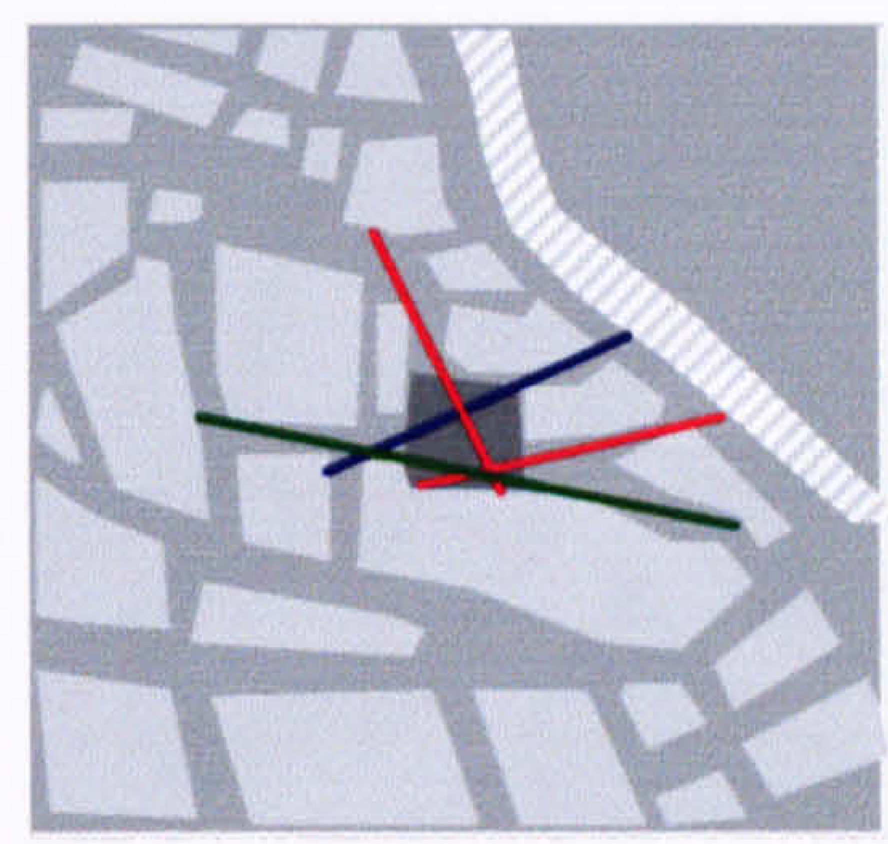


Fig. 6. Kempten - Germany

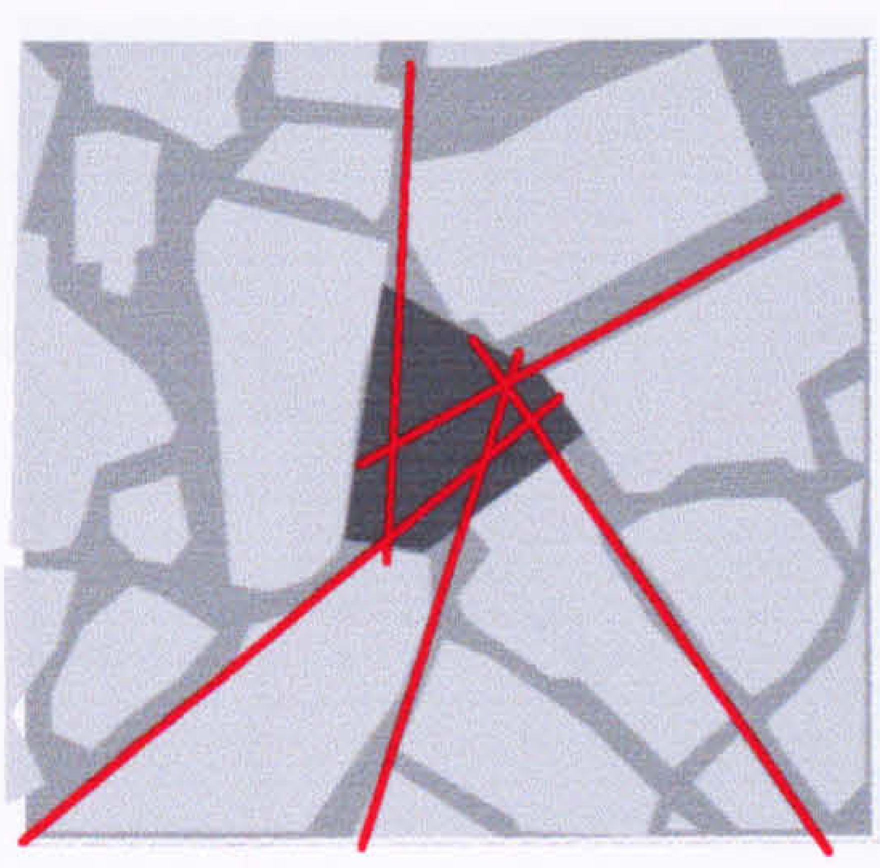


Fig. 7. Kutna Hora - Czech Republic

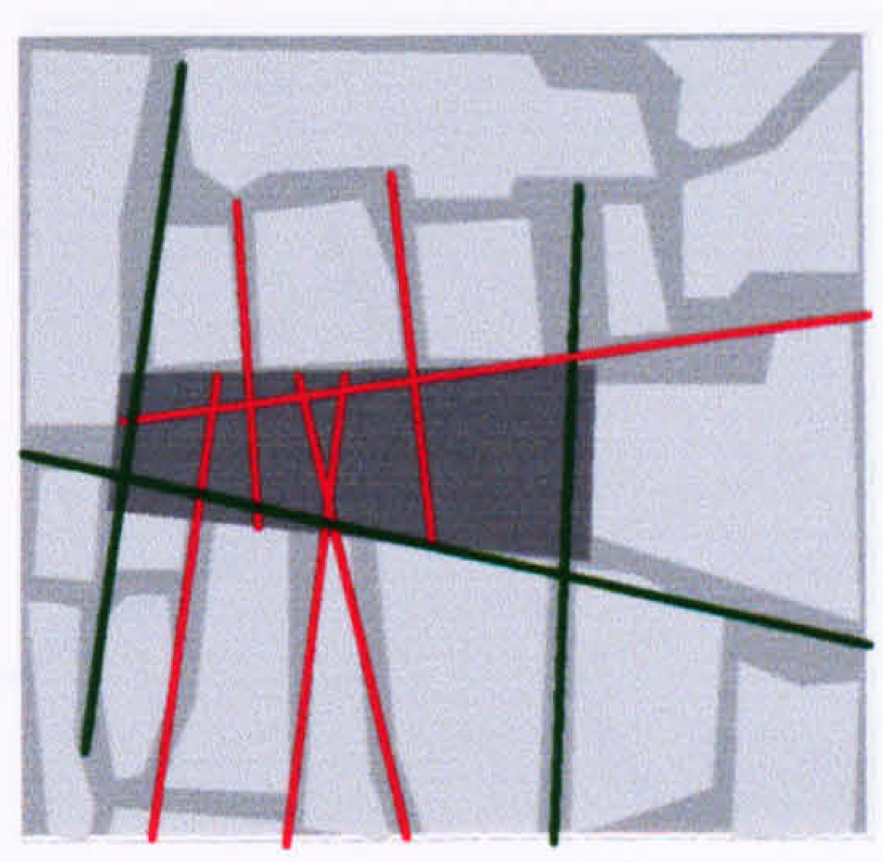


Fig. 8. Magdeburg - Germany

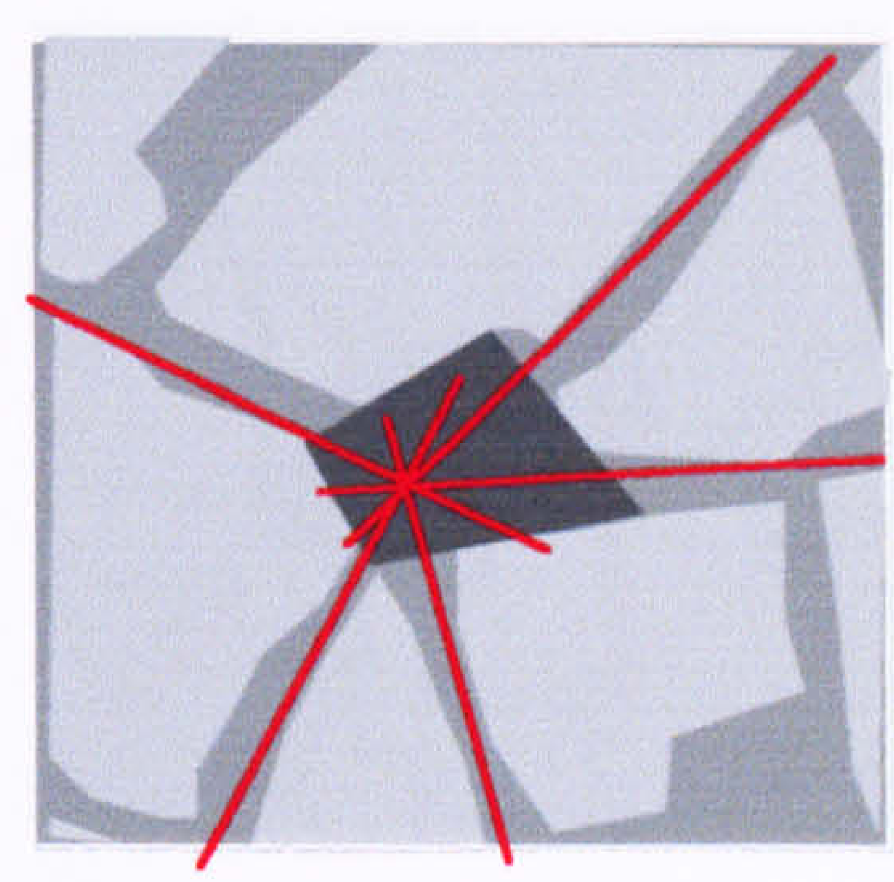


Fig. 9. Moguer - Spain

Plate 3.4. Main convex element - interfacing axial lines (2/3)

plans not in scale
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convergent axial line
transverse axial line
peripheric axial line

main convex element
urban blocks
open space

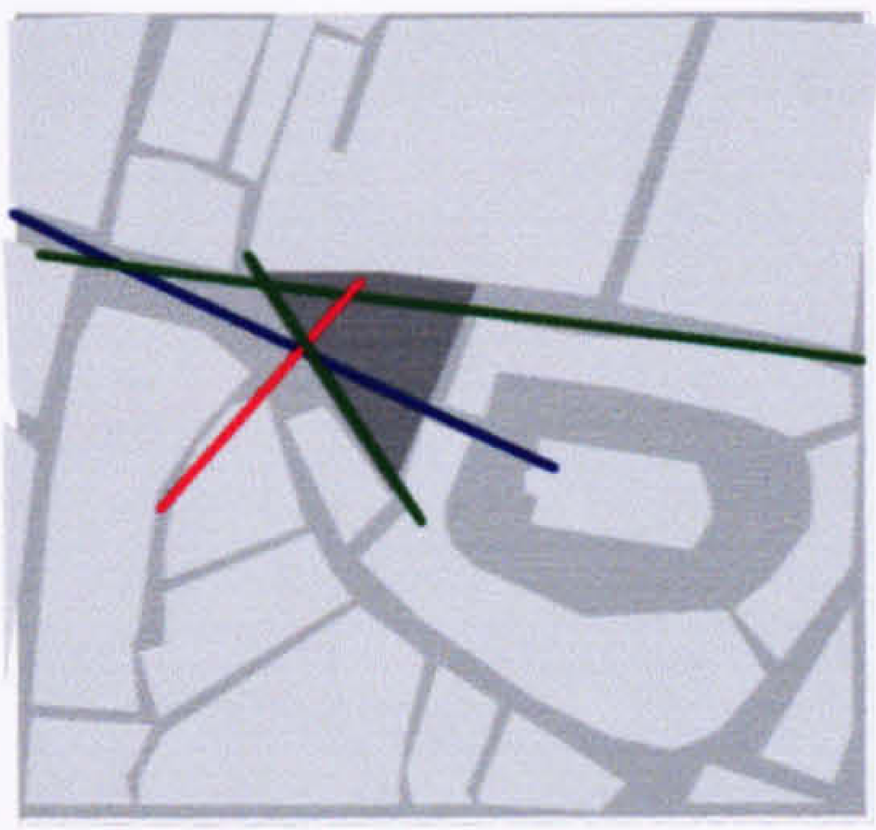

Fig. 10. Nijmegen - Netherlands

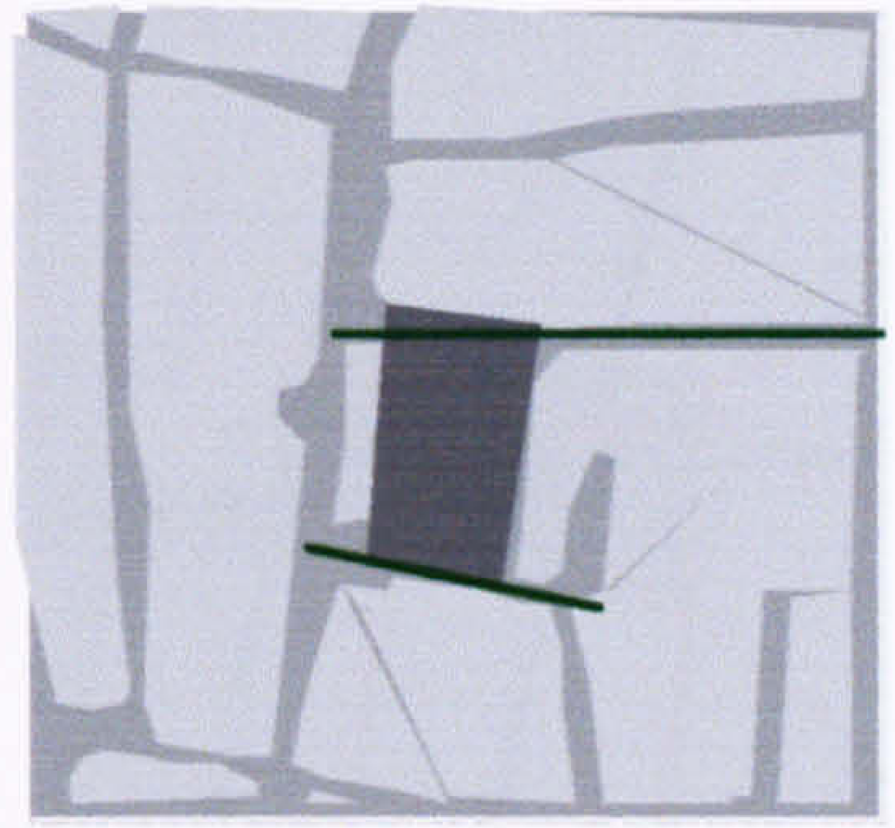

Fig. 11. Palencia - Spain

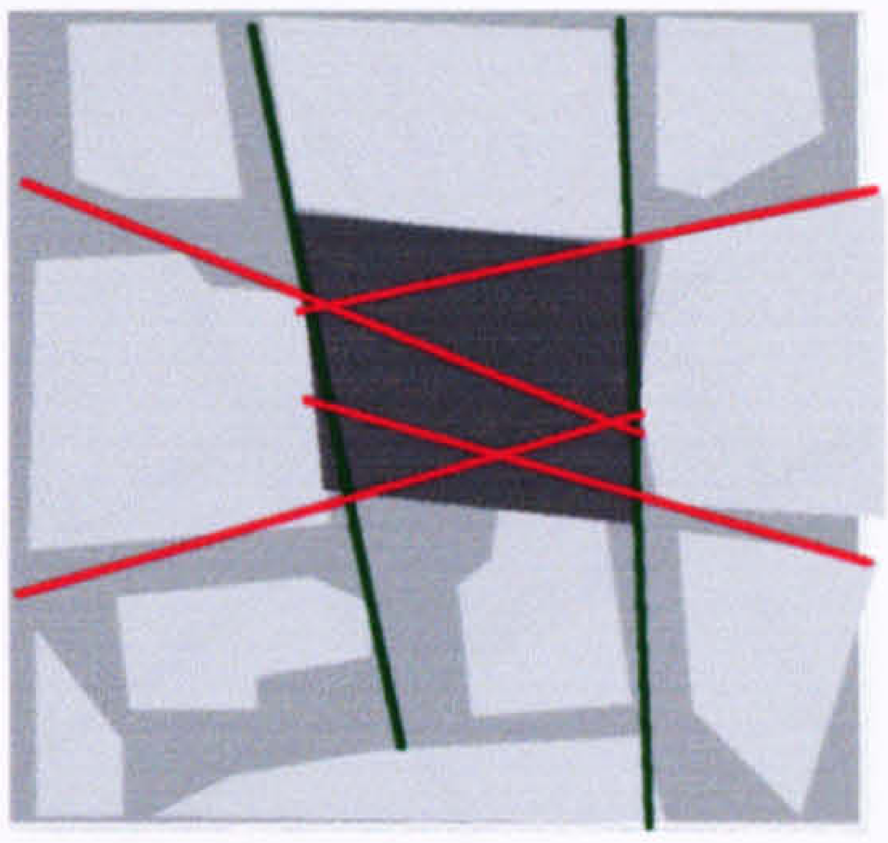

Fig. 12. Pest - Hungary

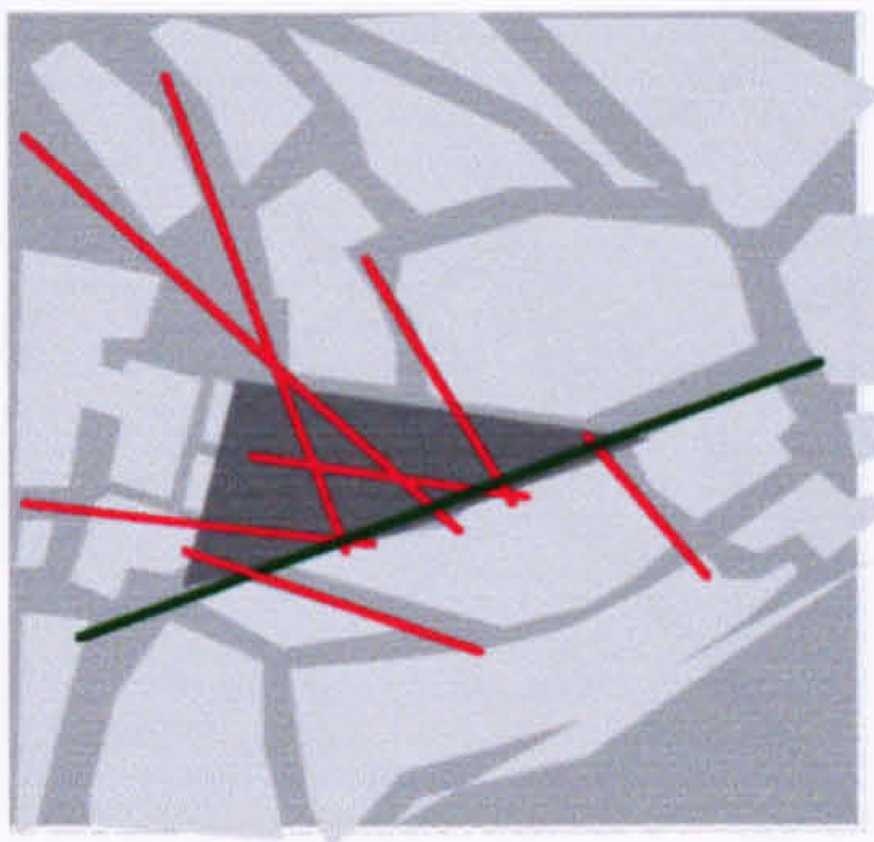

Fig. 13. San Gimignano - Italy

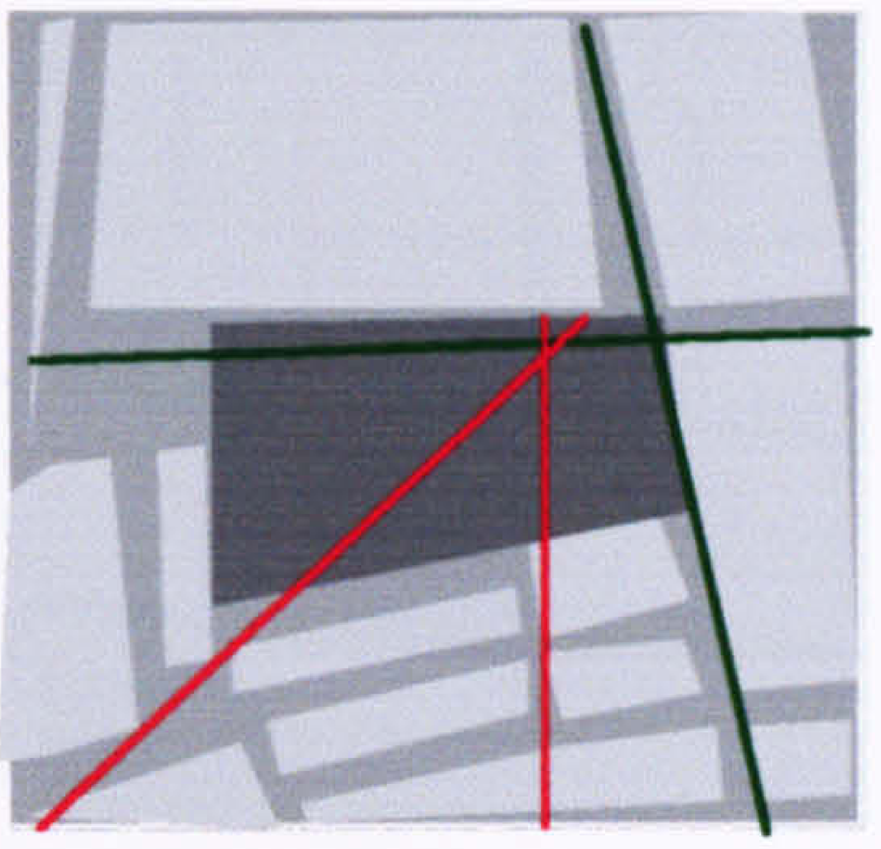

Fig. 14. Salisbury - U.K.

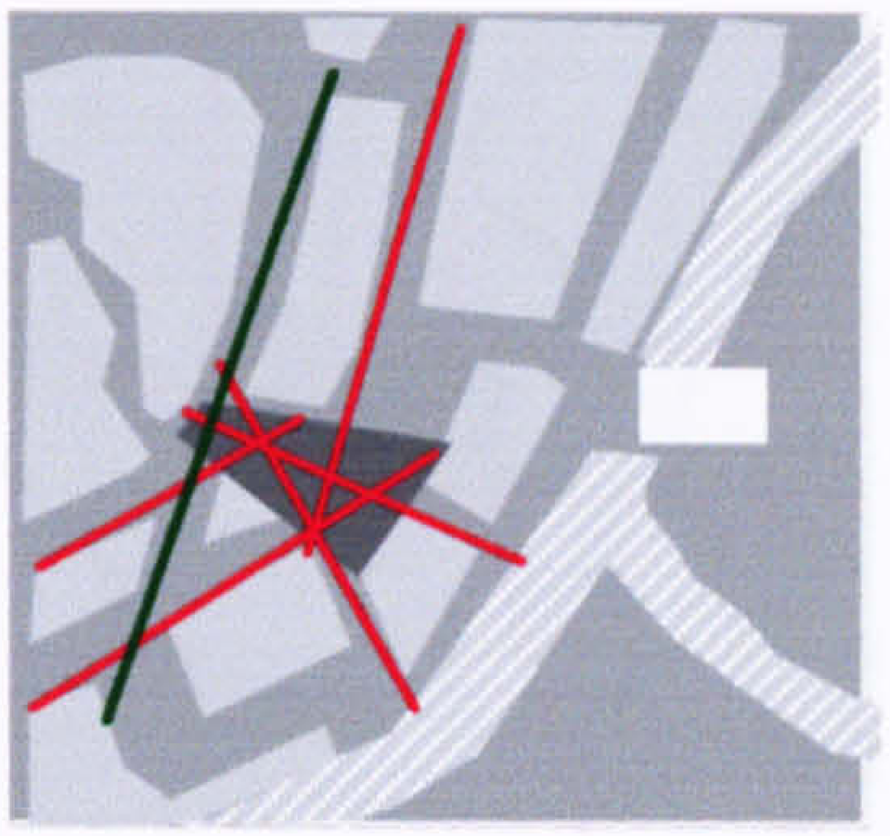

Fig. 15. Verdun- France

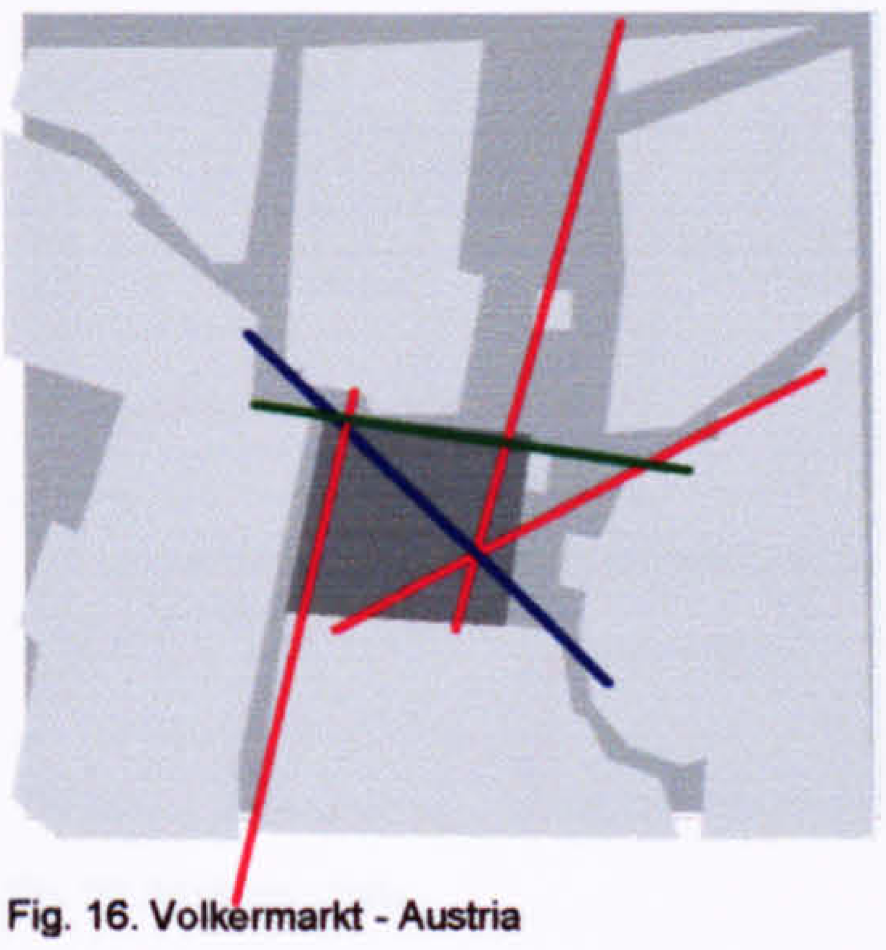

Fig. 16. Volkermarkt - Austria

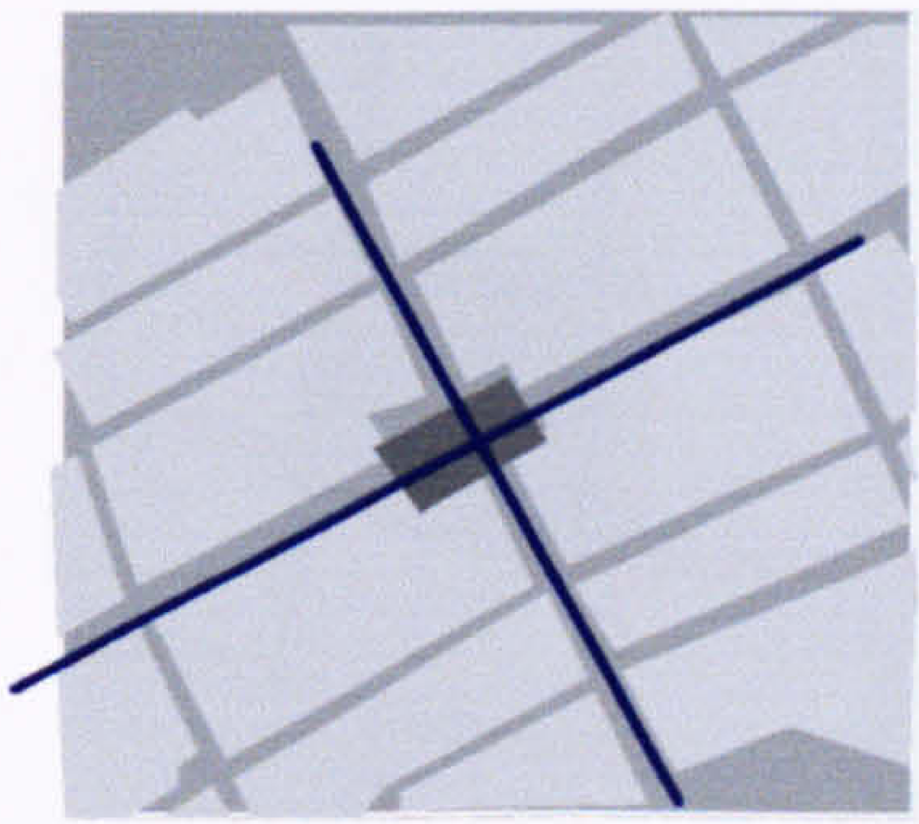

Fig. 17. Borgomanero - Italy

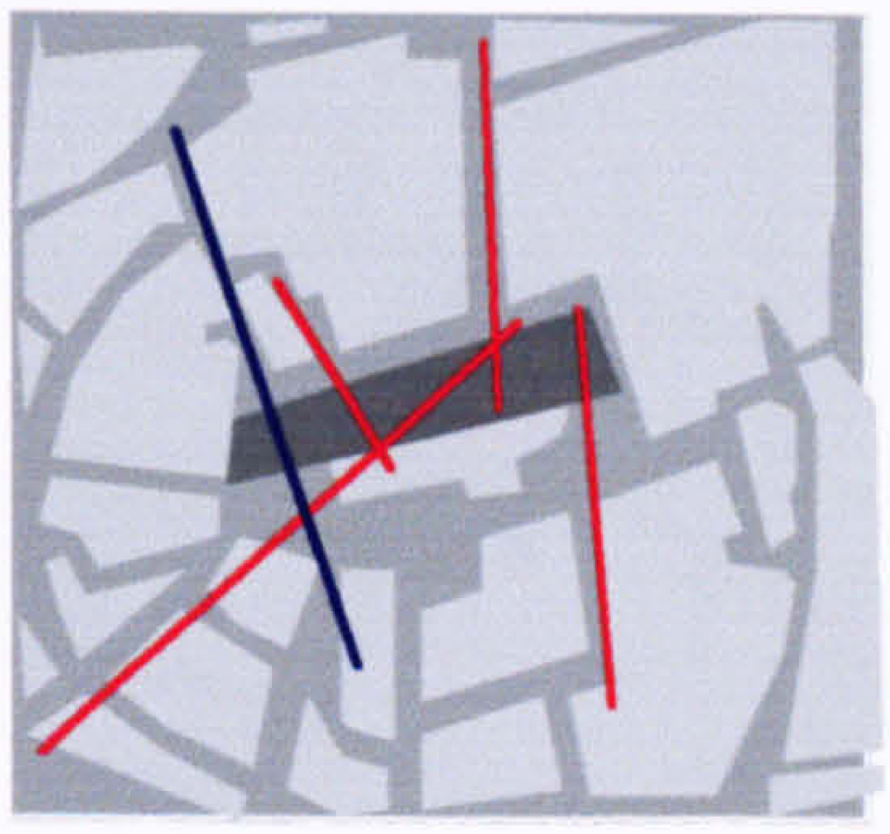

Fig. 18. Brive - France

Plate 3.4. Main convex element - interfacing axial lines (3/3)

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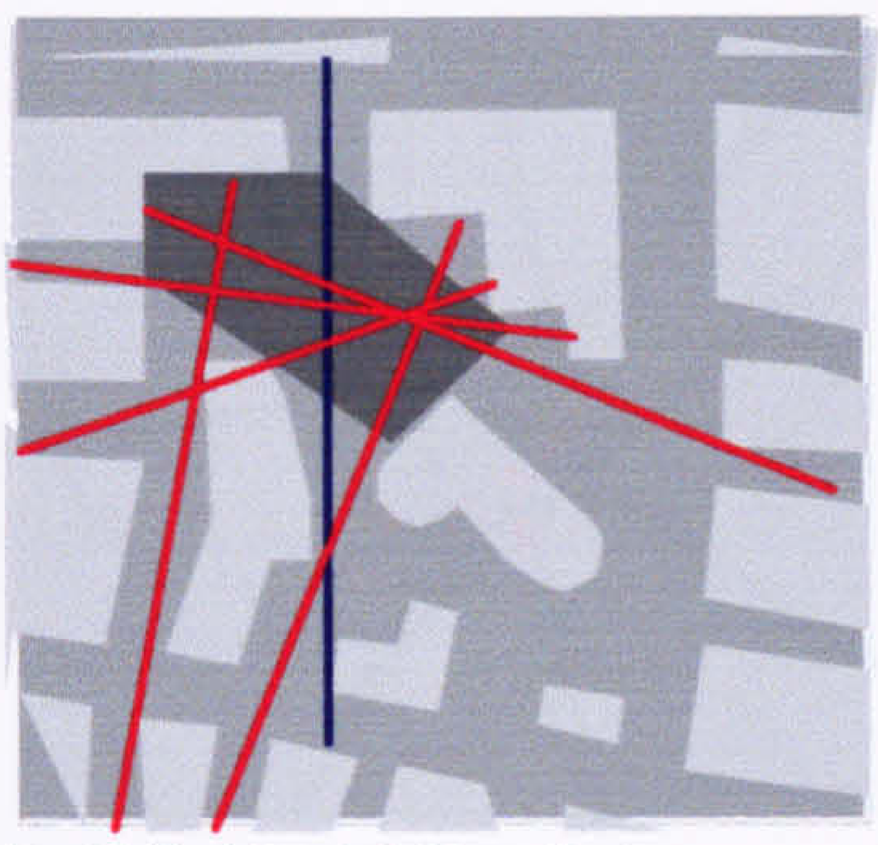


Fig. 19. Castellon de la Plana- Spain

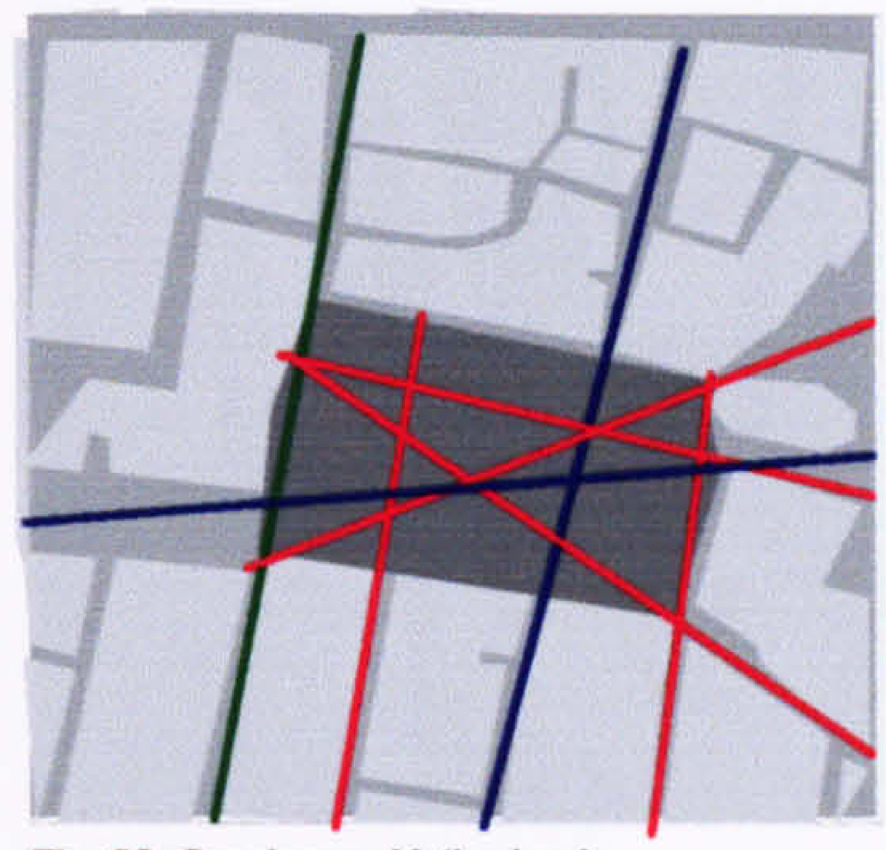


Fig. 20. Groningen- Netherlands

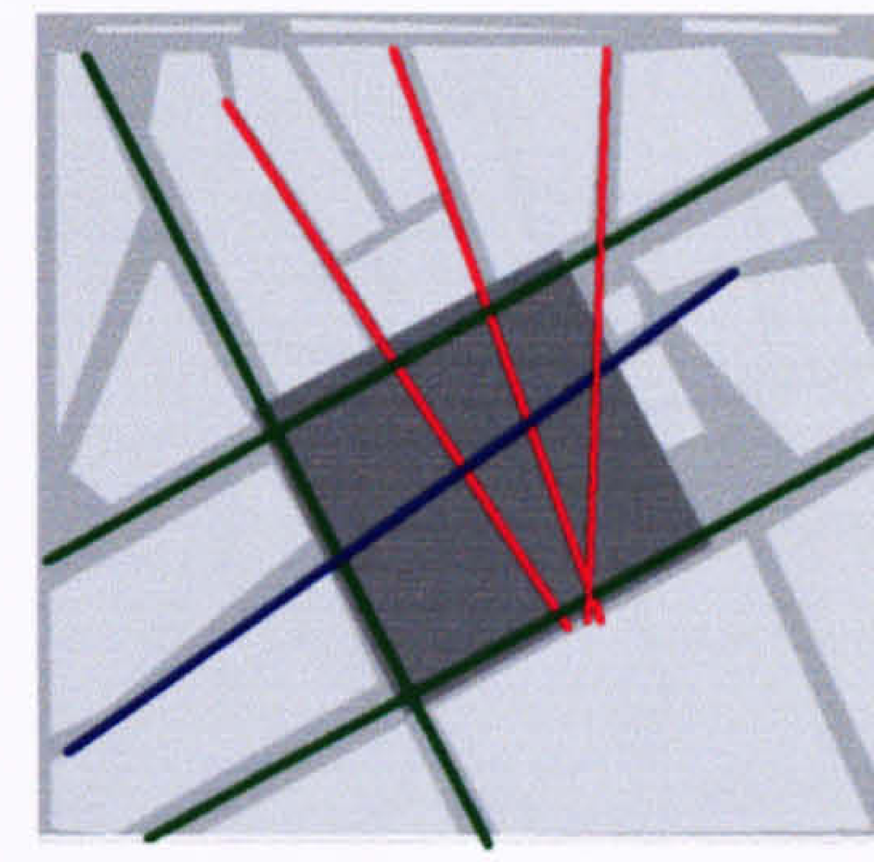


Fig. 21. Gyor - Hungary

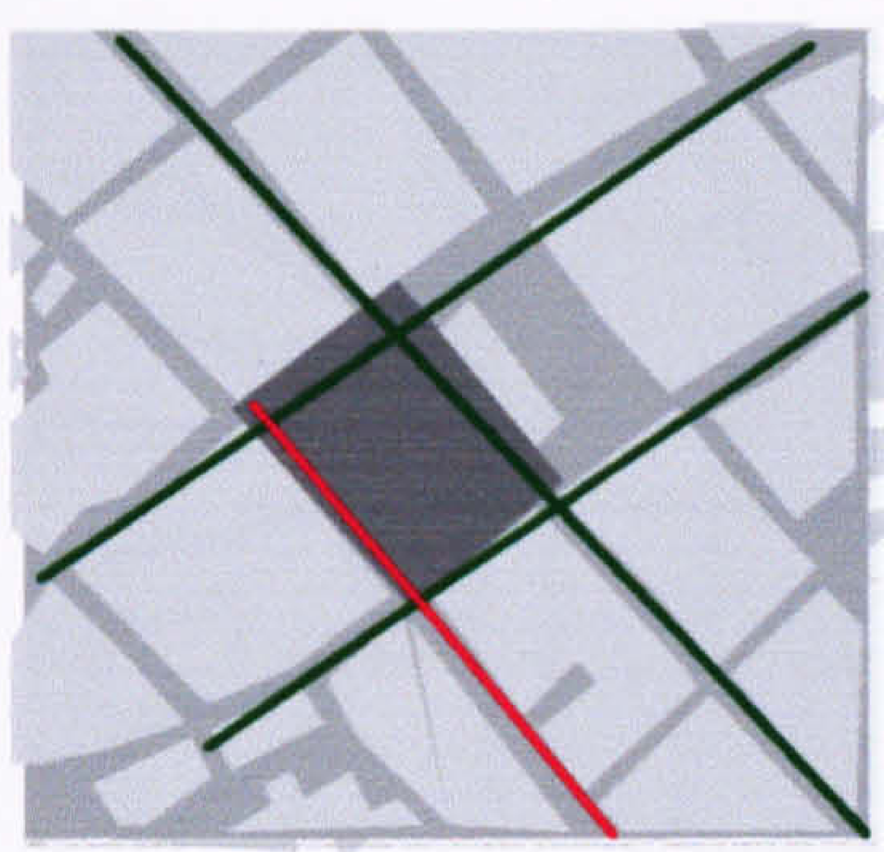


Fig. 22. Kalisz - Poland

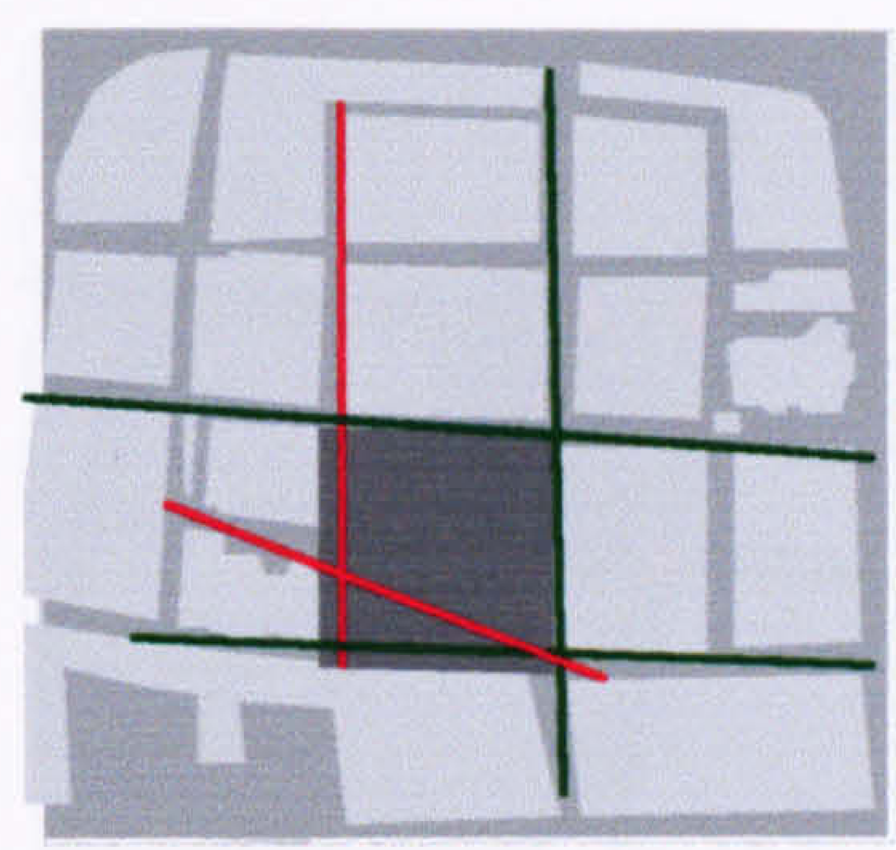


Fig. 23. Klatovy - Czech Republic

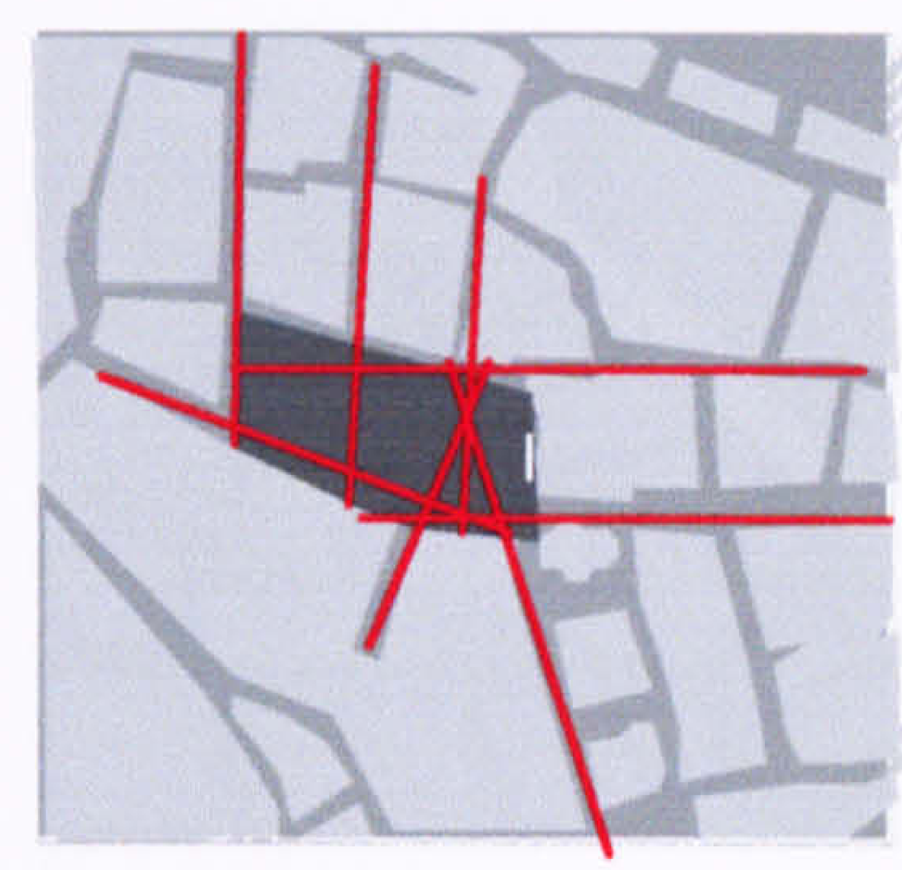


Fig. 24. Litomerice - Czech Republic

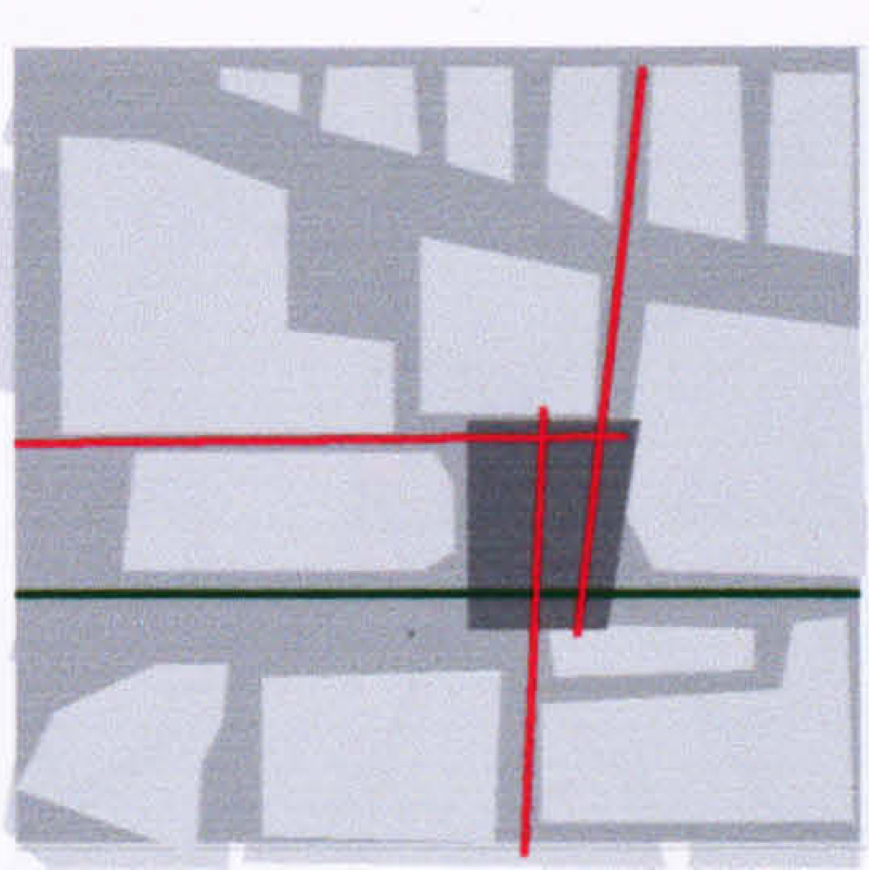


Fig. 25. Modena - Italy

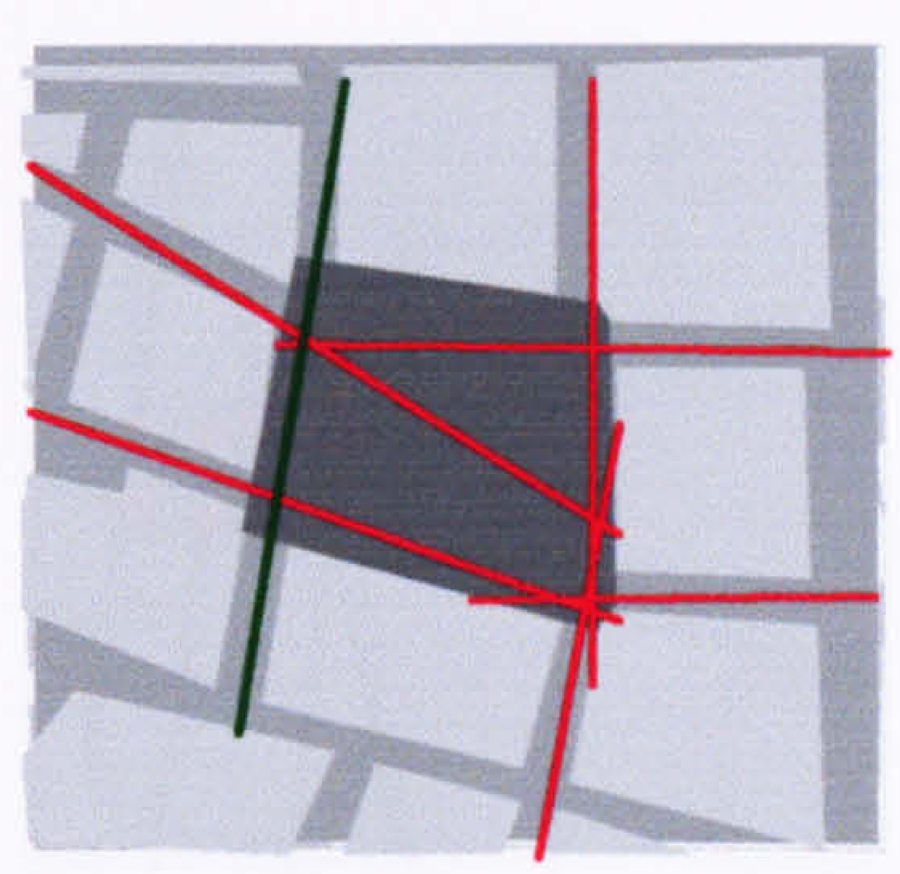


Fig. 26 Montauban- France

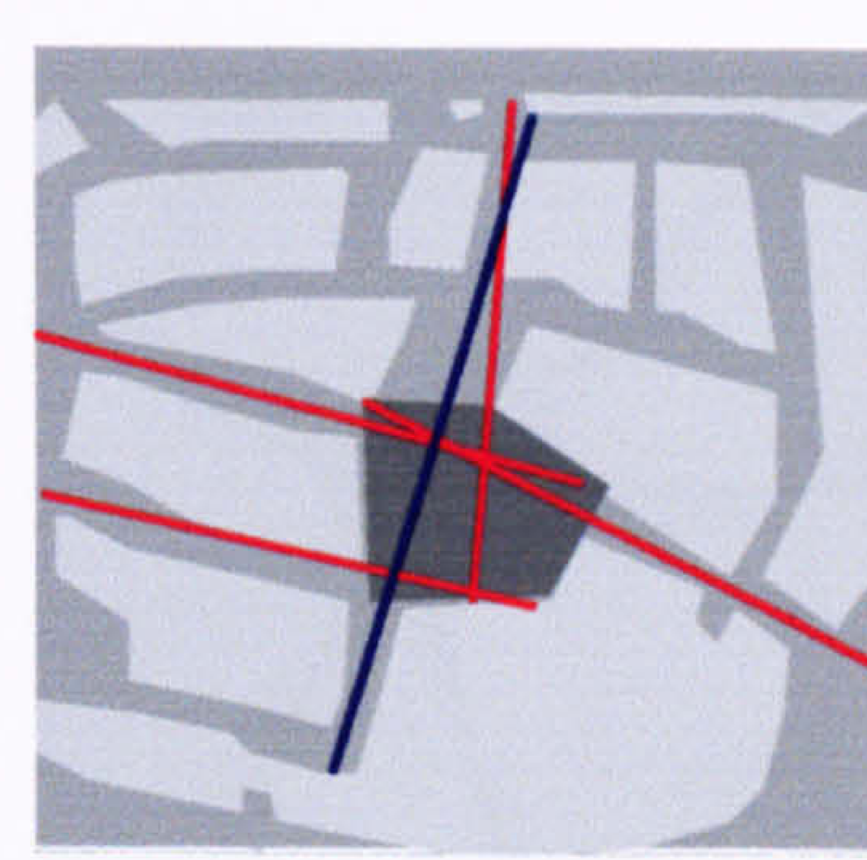


Fig. 27. Portalegre - Portugal

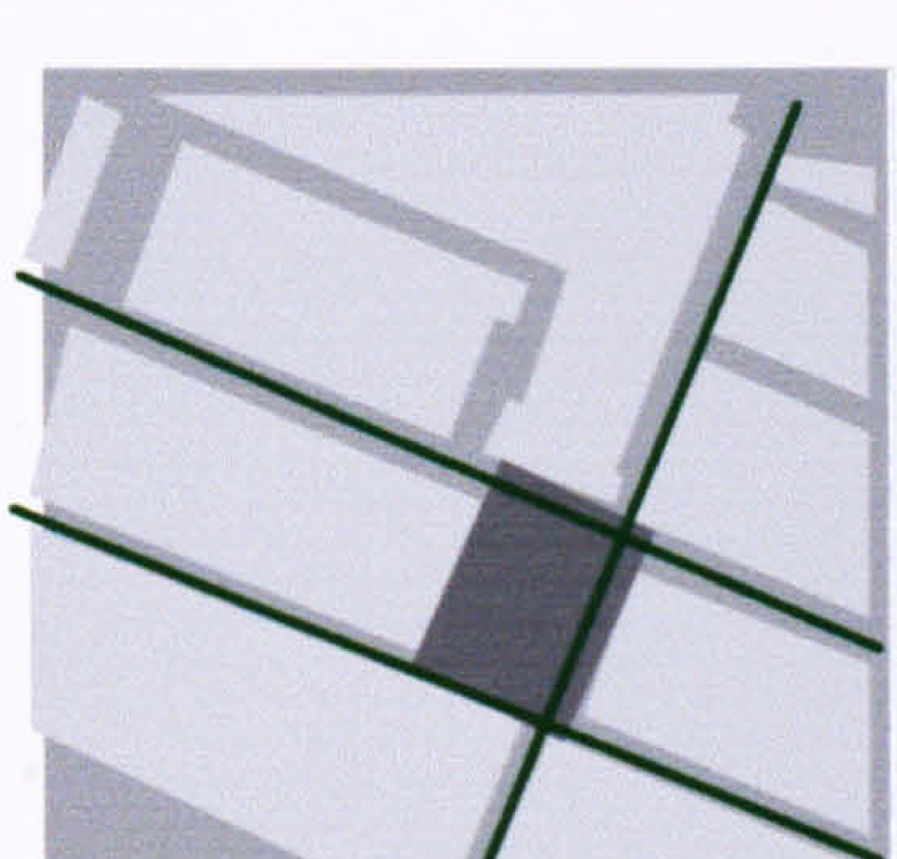


Fig. 28. Scarperia - Italy

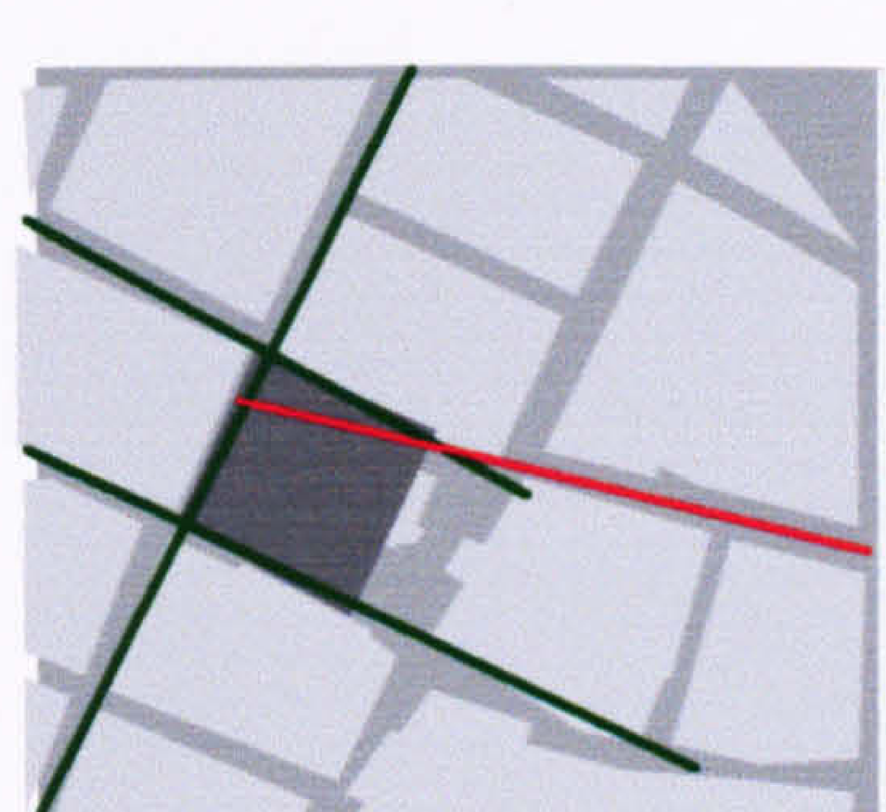


Fig. 29. Wielun - Poland

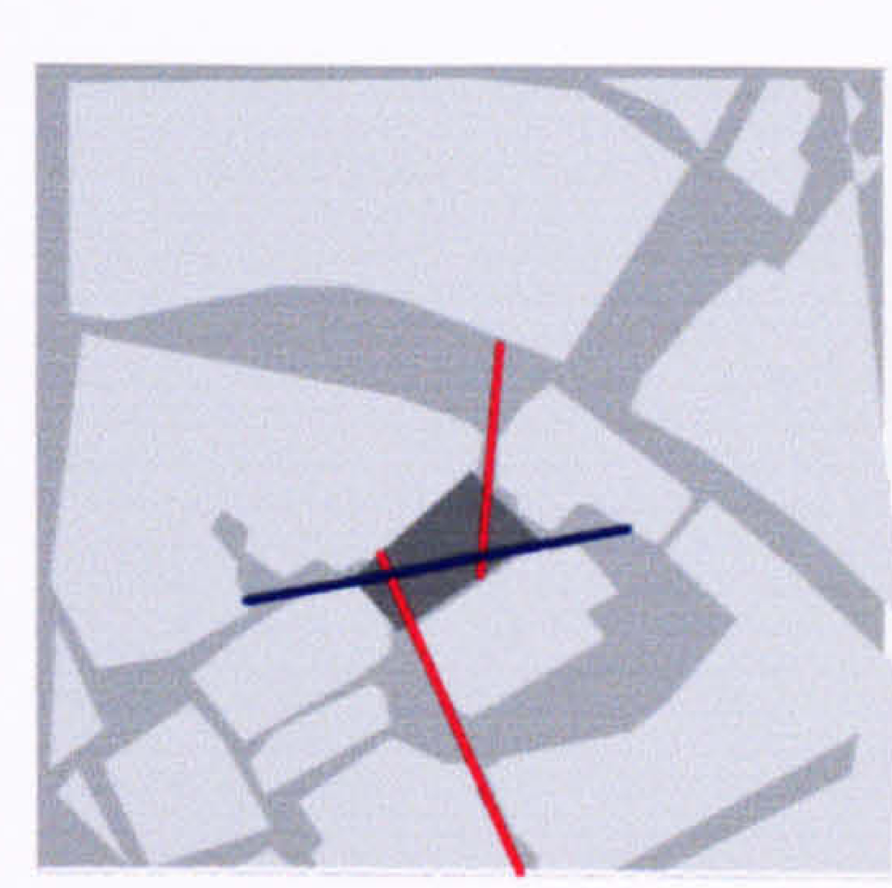


Fig. 30. Wolfsberg - Austria

Plate 3.5. Intersection points (1/3)

plans not in scale
for illustration only

the axial lines shown are the ones that interface with the main convex element only

—— axial lines

● intersection of 2 axial lines

● intersection of 3 or more axial lines

main convex element

urban blocks

open space

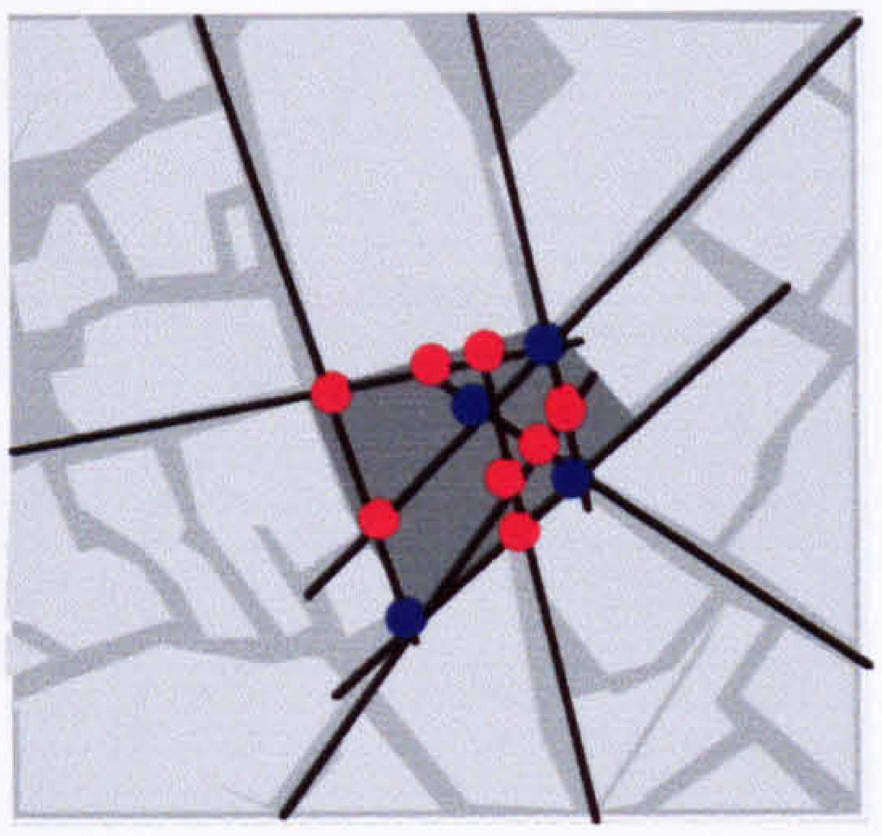


Fig. 1. Bruges - Belgium

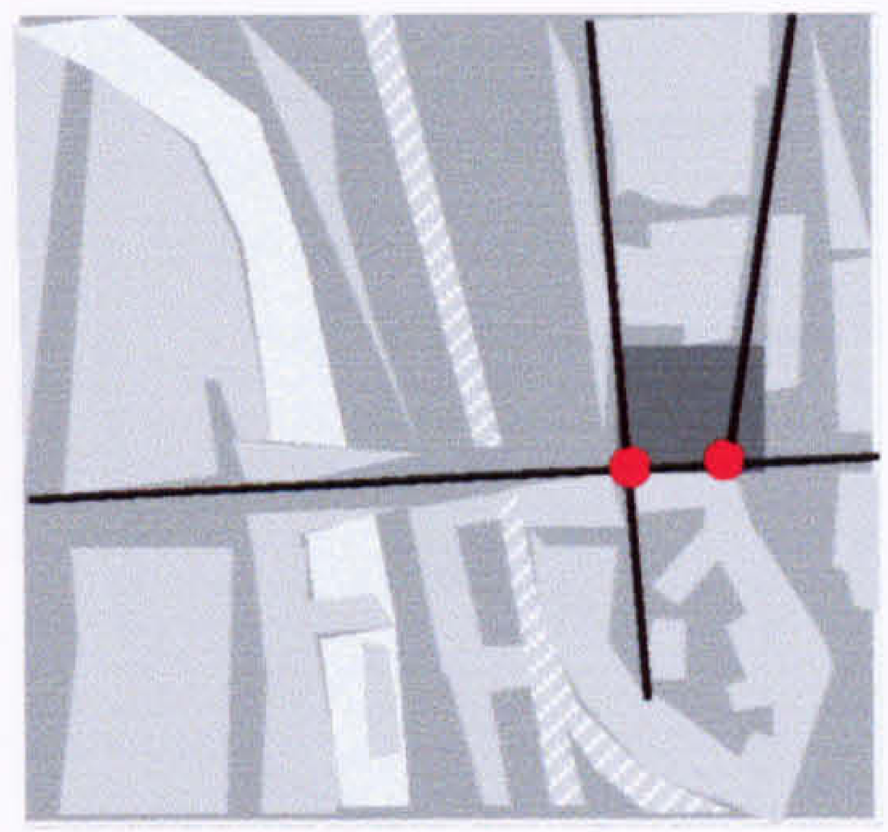


Fig. 2. Caernarvon - UK

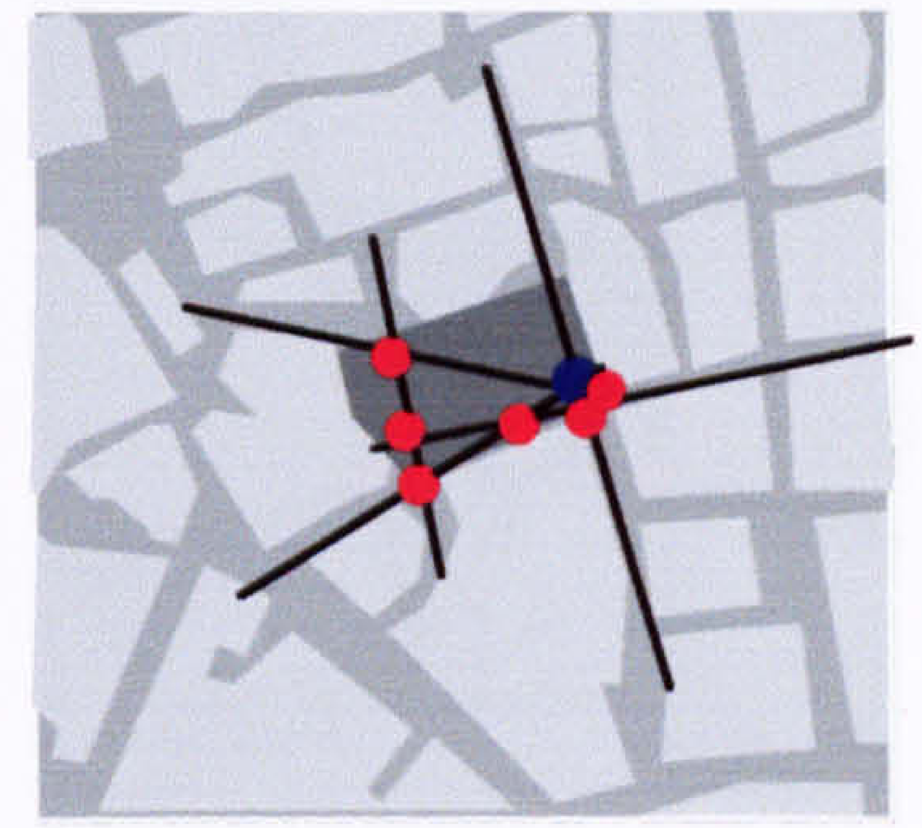


Fig. 3. Esslingen - Germany

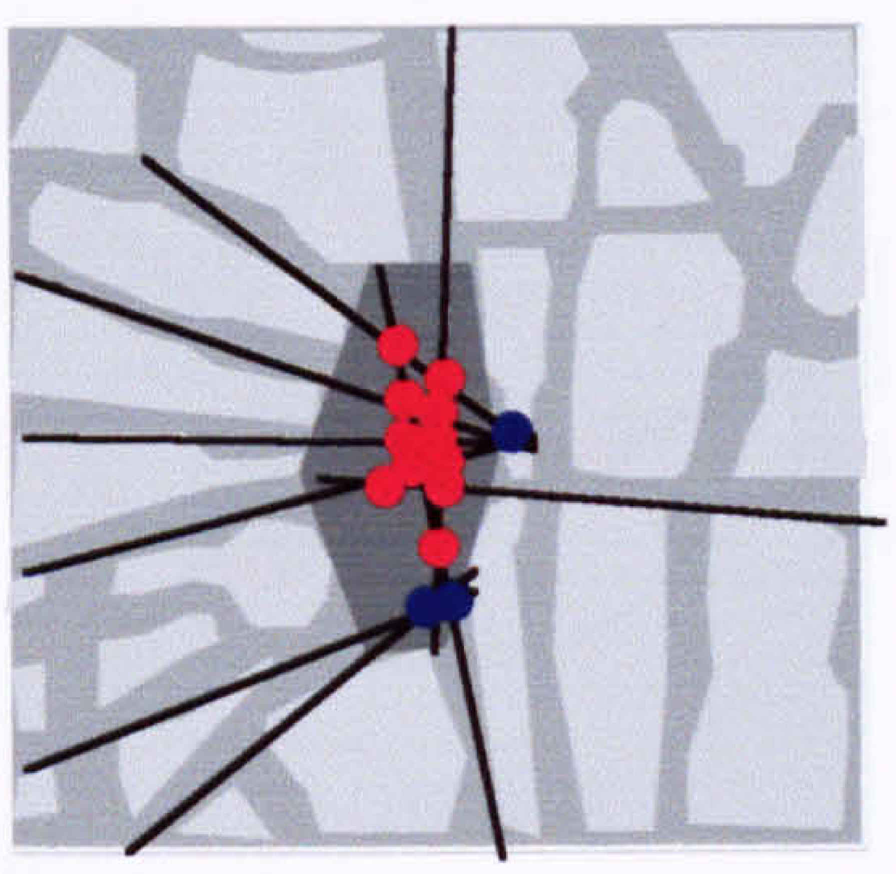


Fig. 4. Evora - Portugal

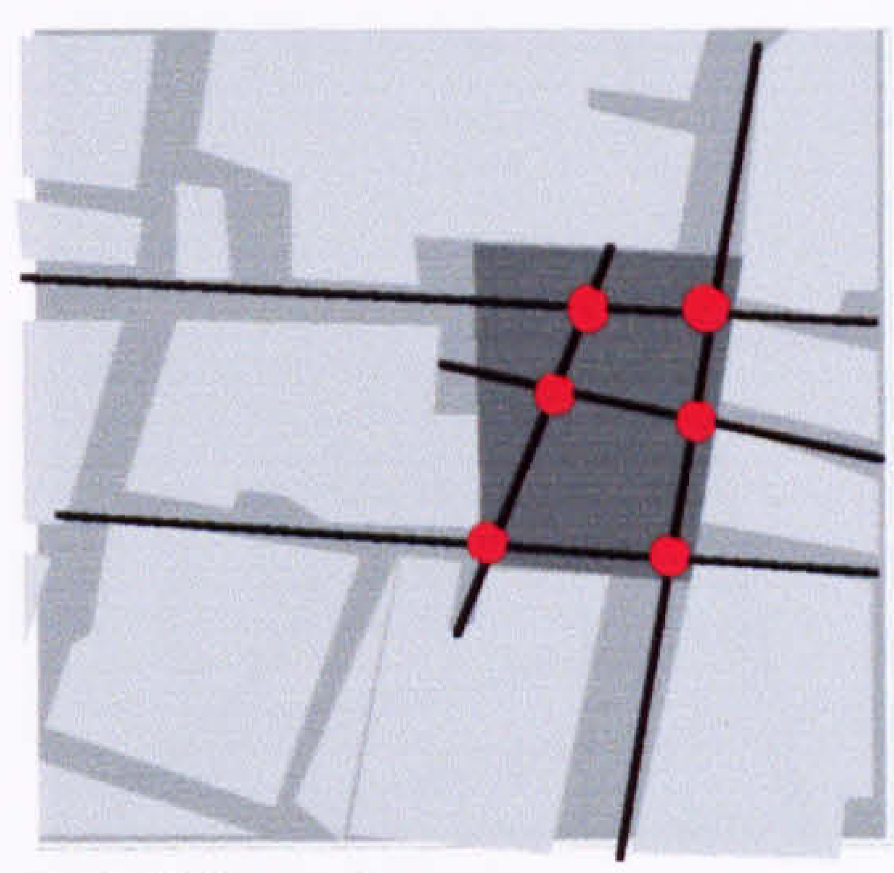


Fig. 5. Heilbronn - Germany

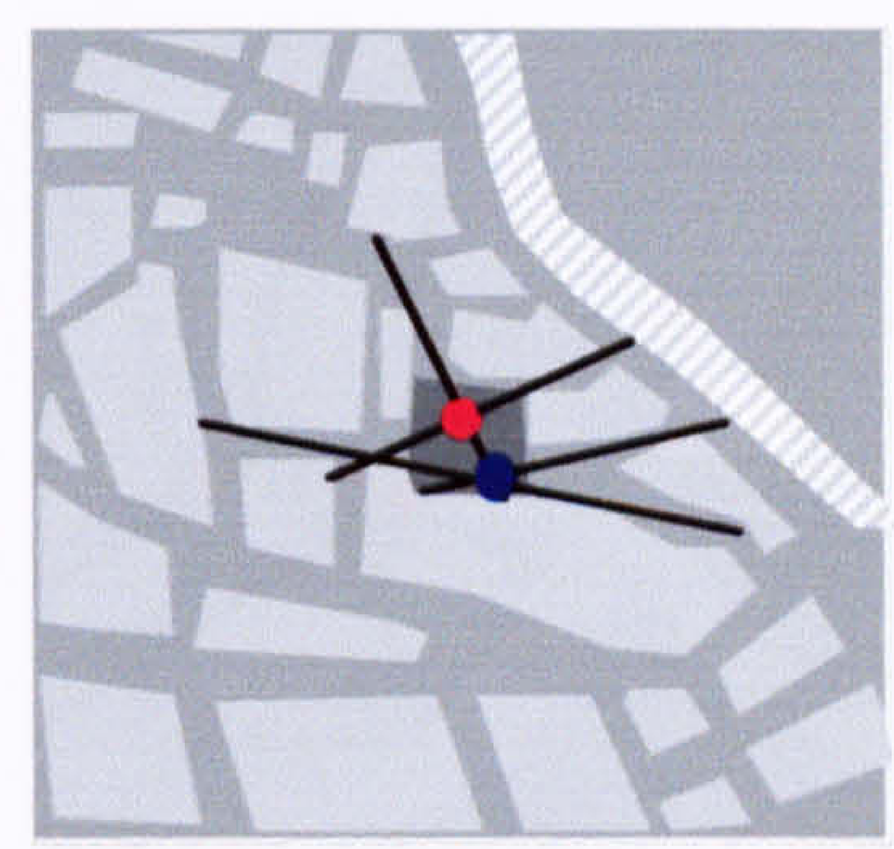


Fig. 6. Kempten - Germany

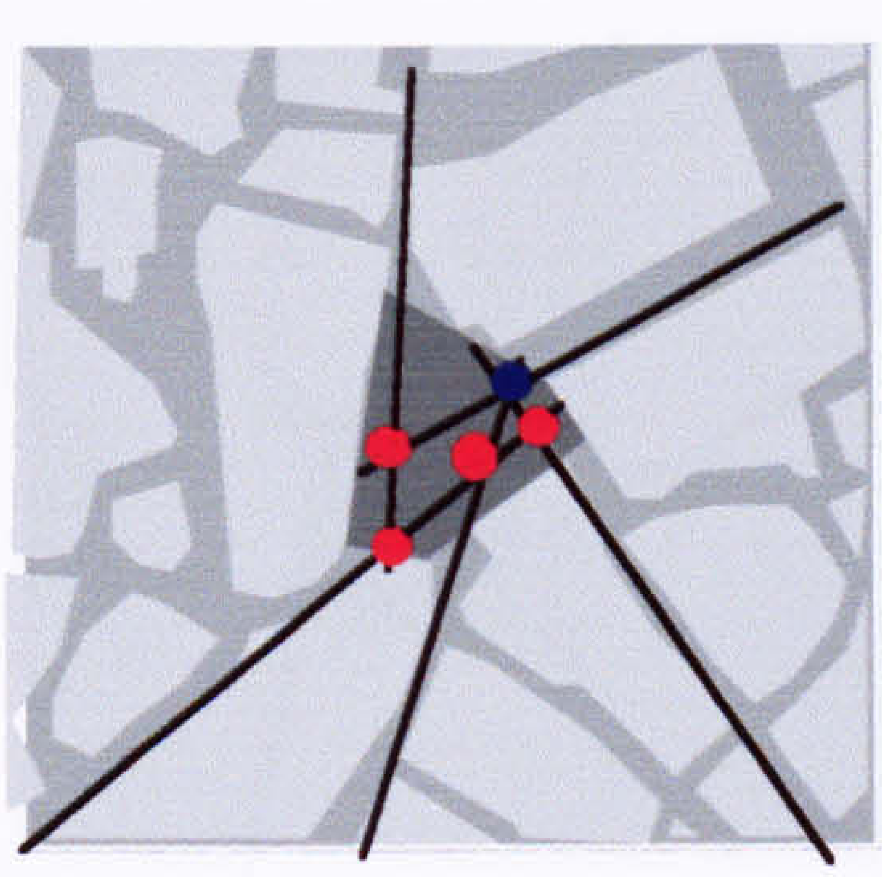


Fig. 7. Kutna Hora - Czech Republic

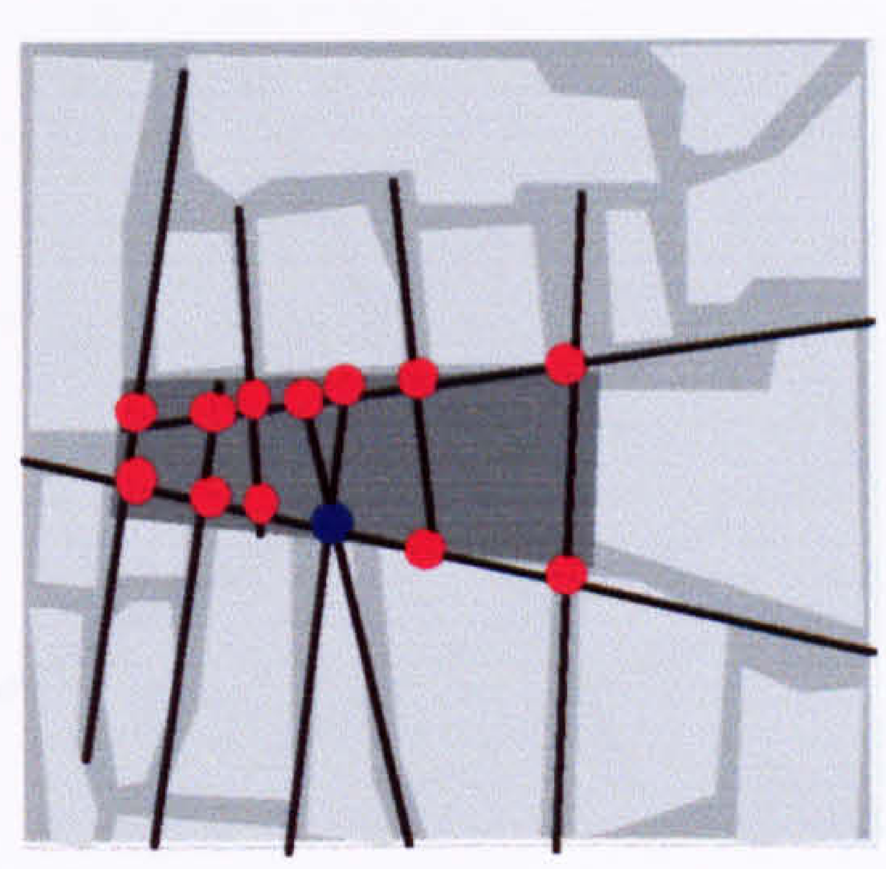


Fig. 8. Magdeburg - Germany

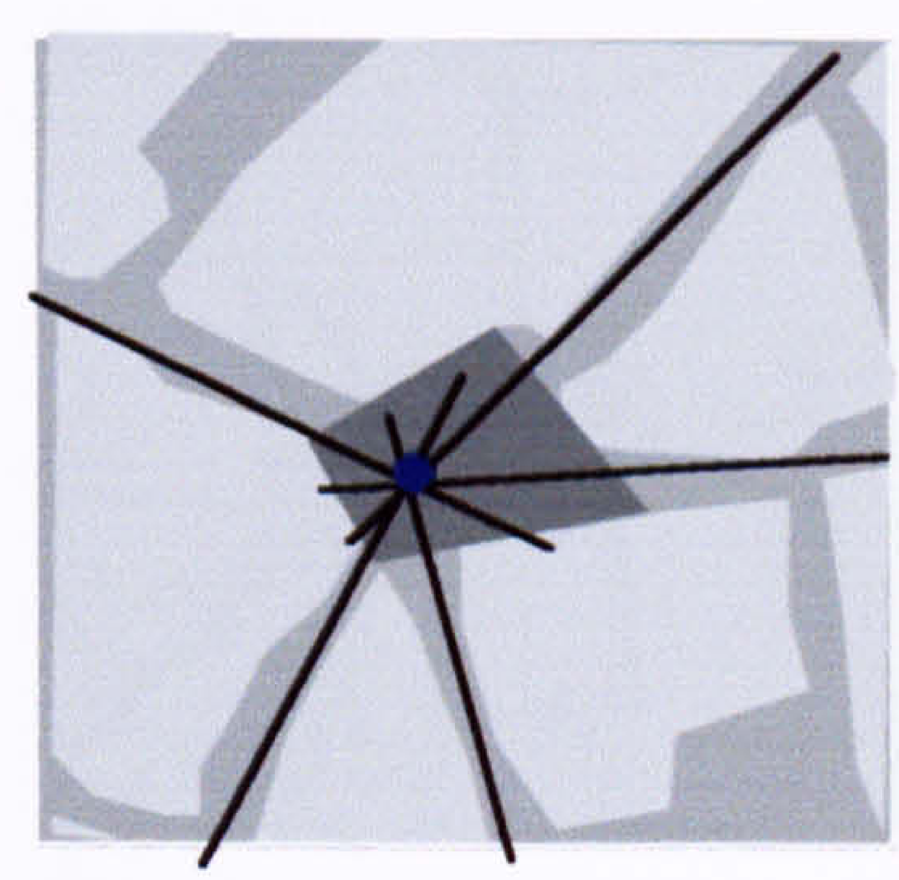


Fig. 9. Moguer - Spain

Plate 3.5. Intersection points (2/3)

plans not in scale
for illustration only

the axial lines shown are the ones that interface with the main convex element only

axial lines

intersection of 2 axial lines

intersection of 3 or more axial lines

main convex element

urban blocks

open space

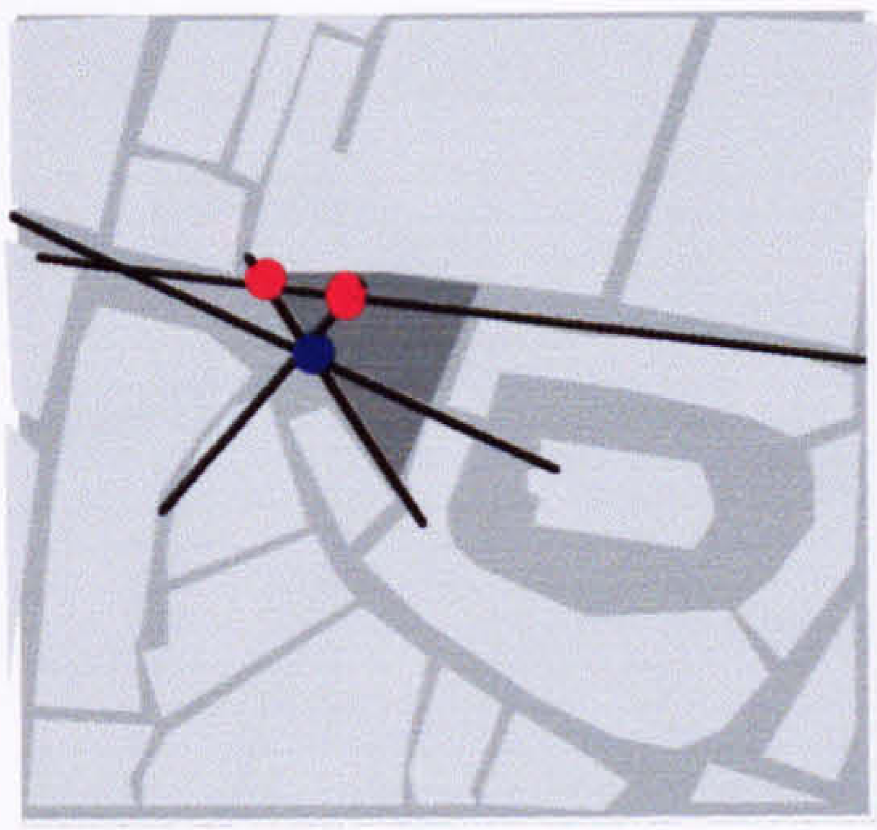


Fig. 10. Nijmegen - Netherlands

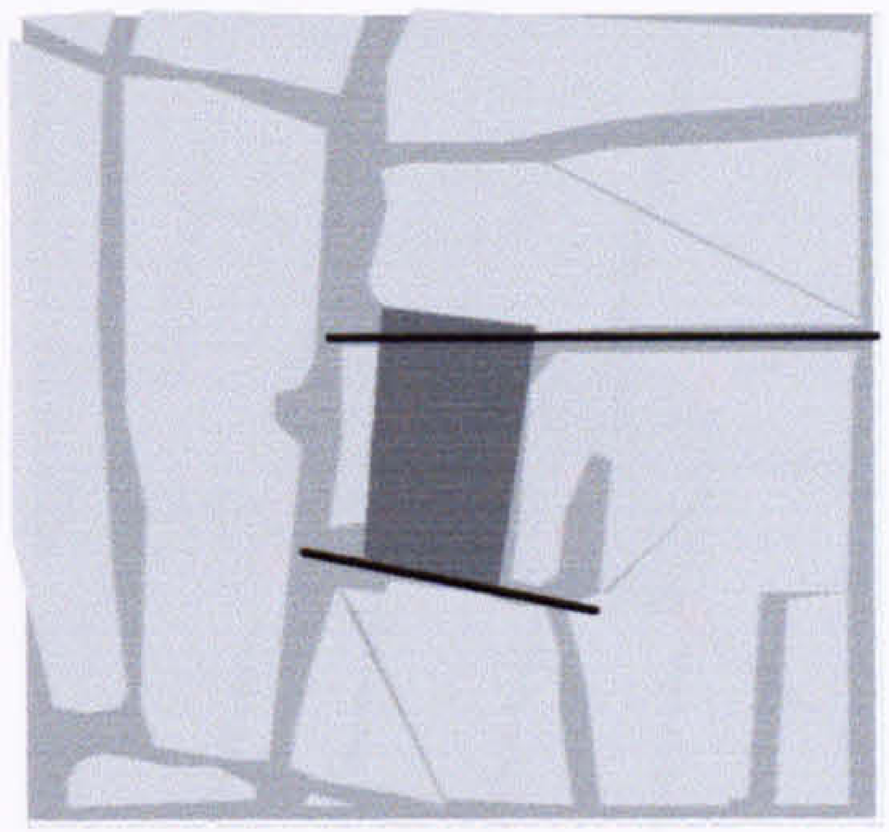


Fig. 11. Palencia - Spain

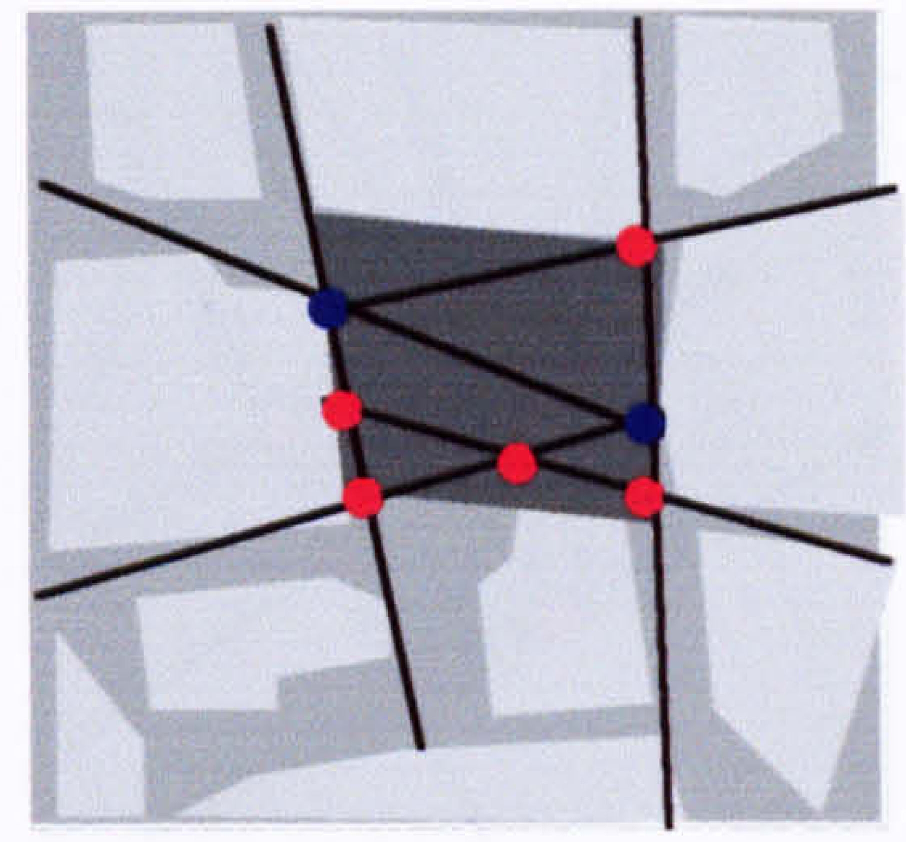


Fig. 12. Pest - Hungary

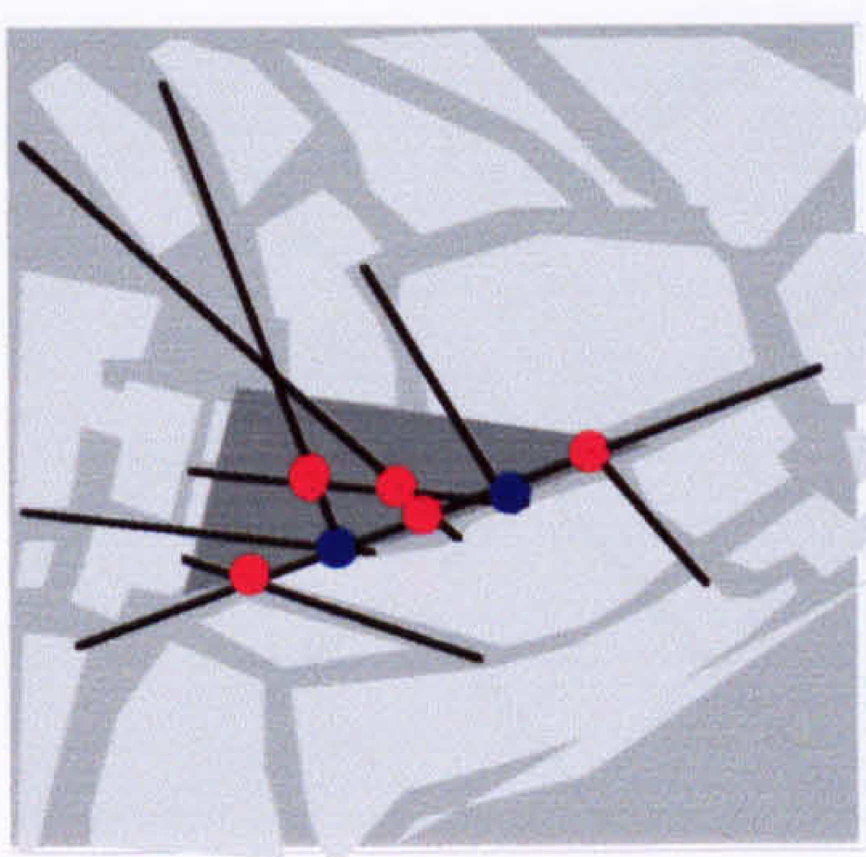


Fig. 13. San Gimignano - Italy

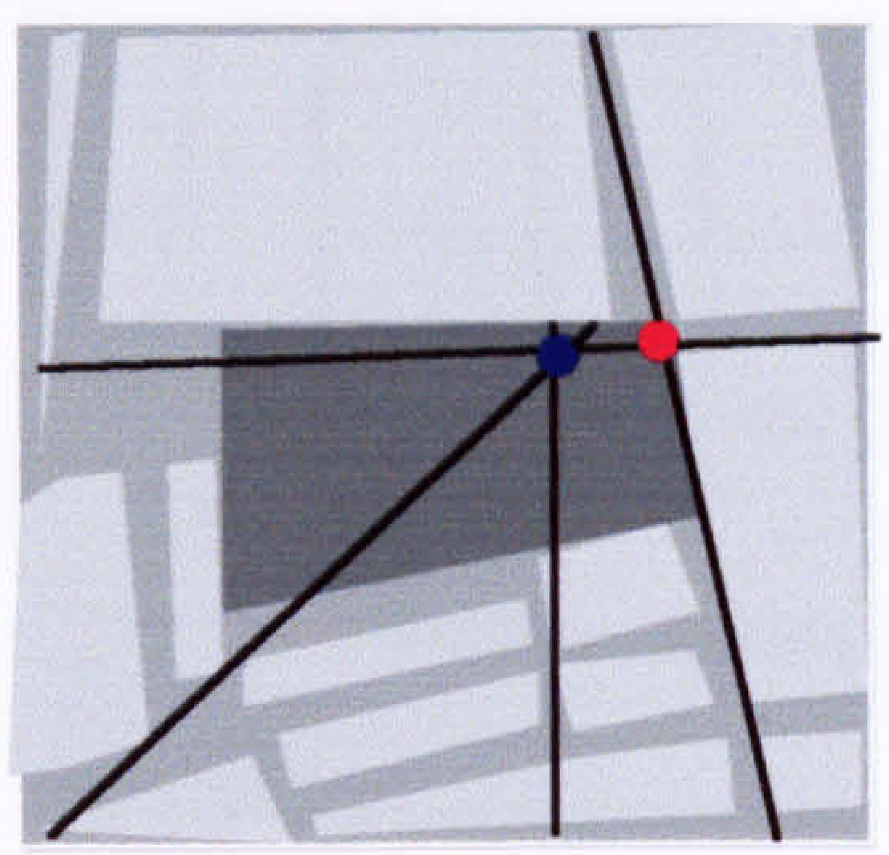


Fig. 14. Salisbury - U.K.

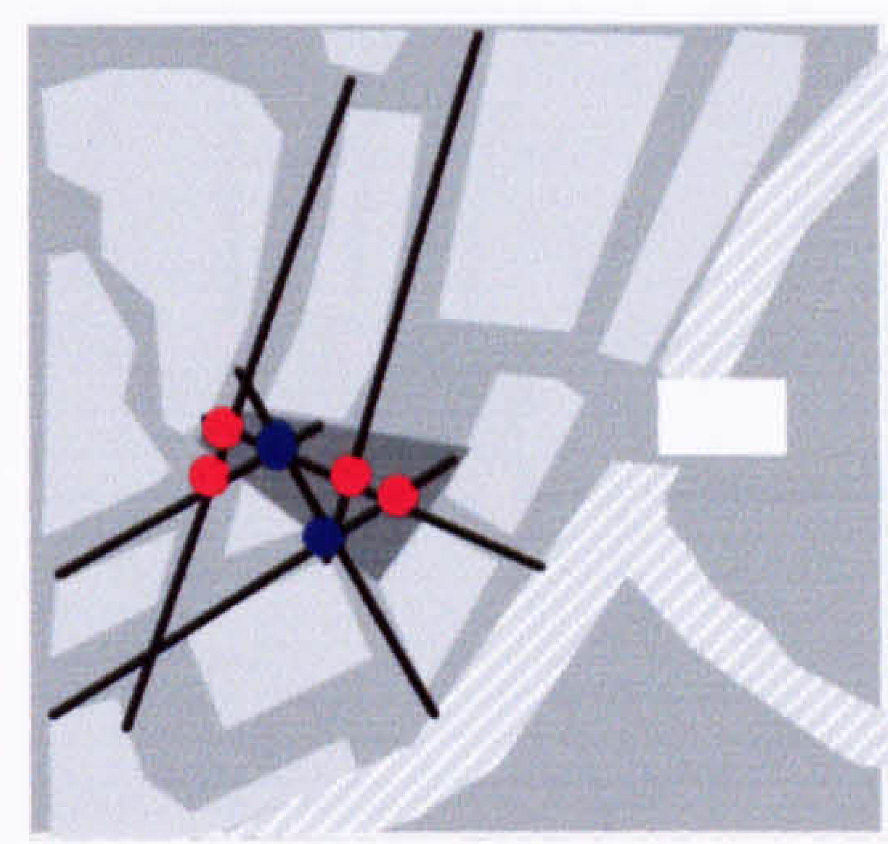


Fig. 15. Verdun- France

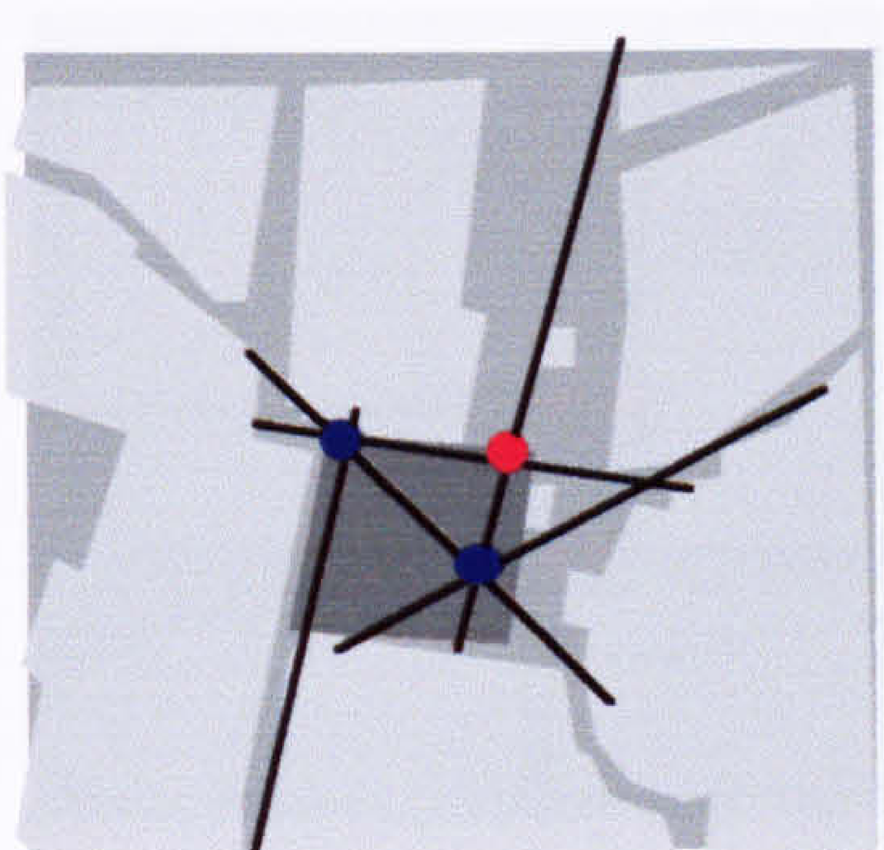


Fig. 16. Volkermarkt - Austria

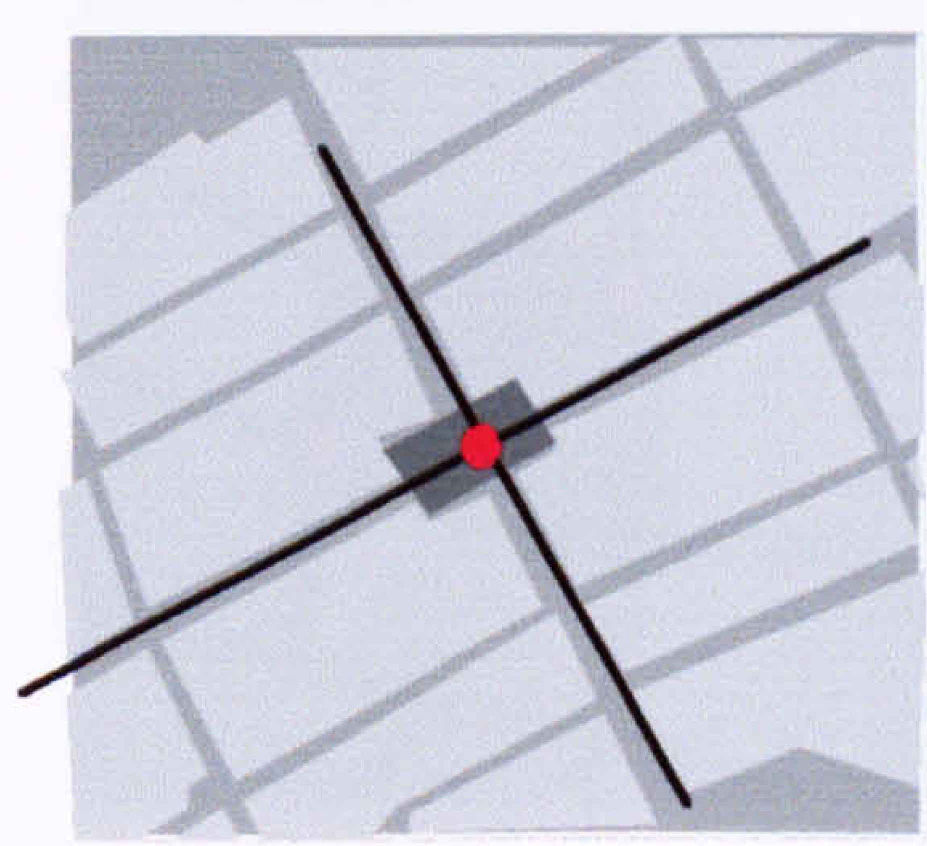


Fig. 17. Borgomanero - Italy

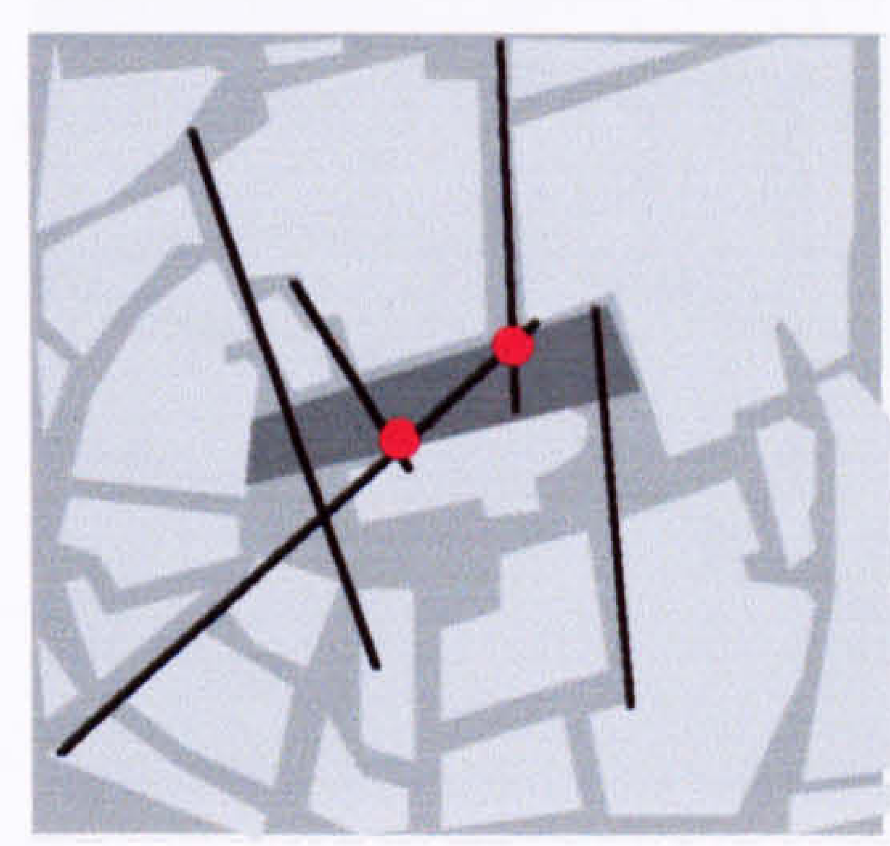


Fig. 18. Brive - France

Plate 3.5. Intersection points (3/3)

plans not in scale
for illustration only

the axial lines shown are the ones that interface with
the main convex element only

axial lines

intersection of 2 axial lines

intersection of 2 or more axial lines

main convex element

urban blocks

open space

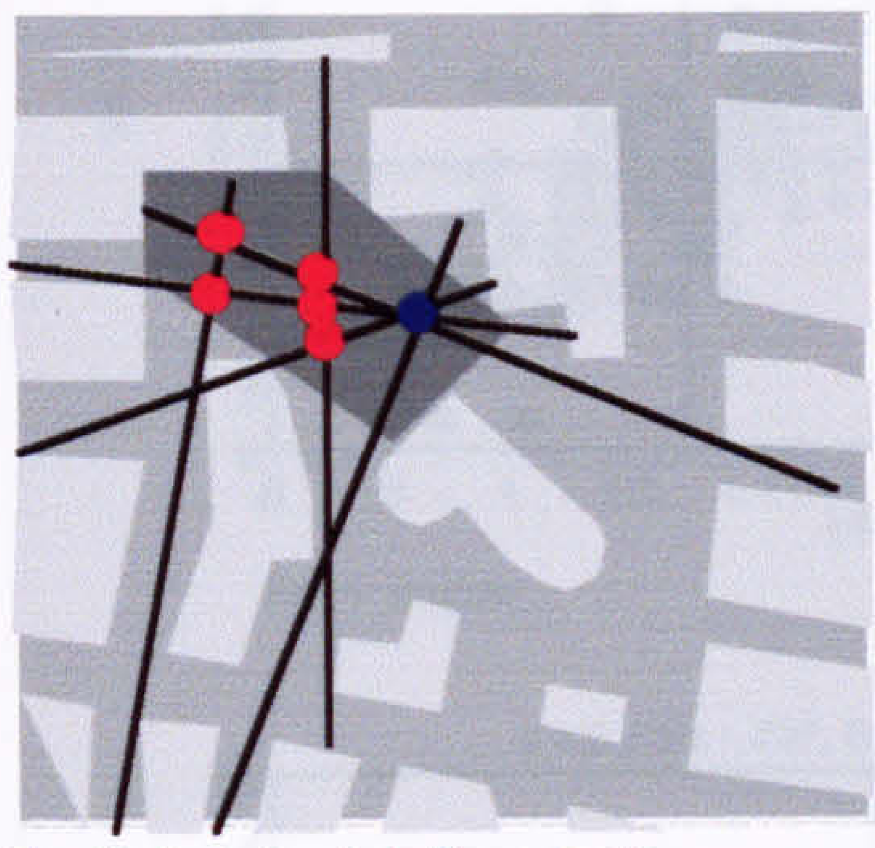


Fig. 19. Castellon de la Plana- Spain

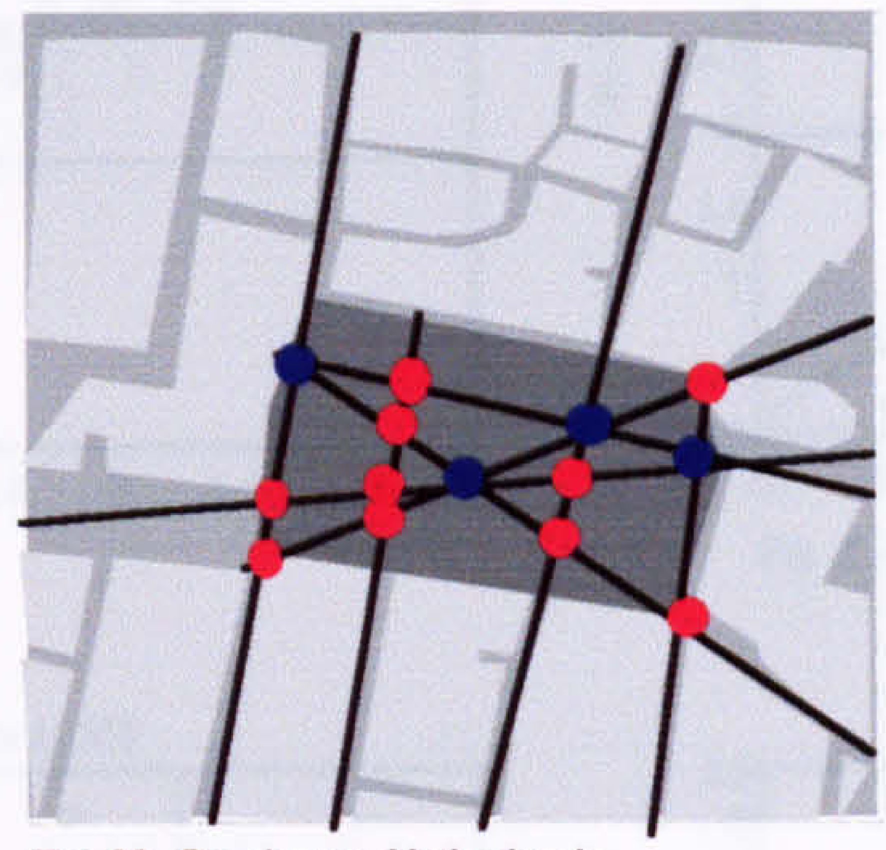


Fig. 20. Groningen- Netherlands

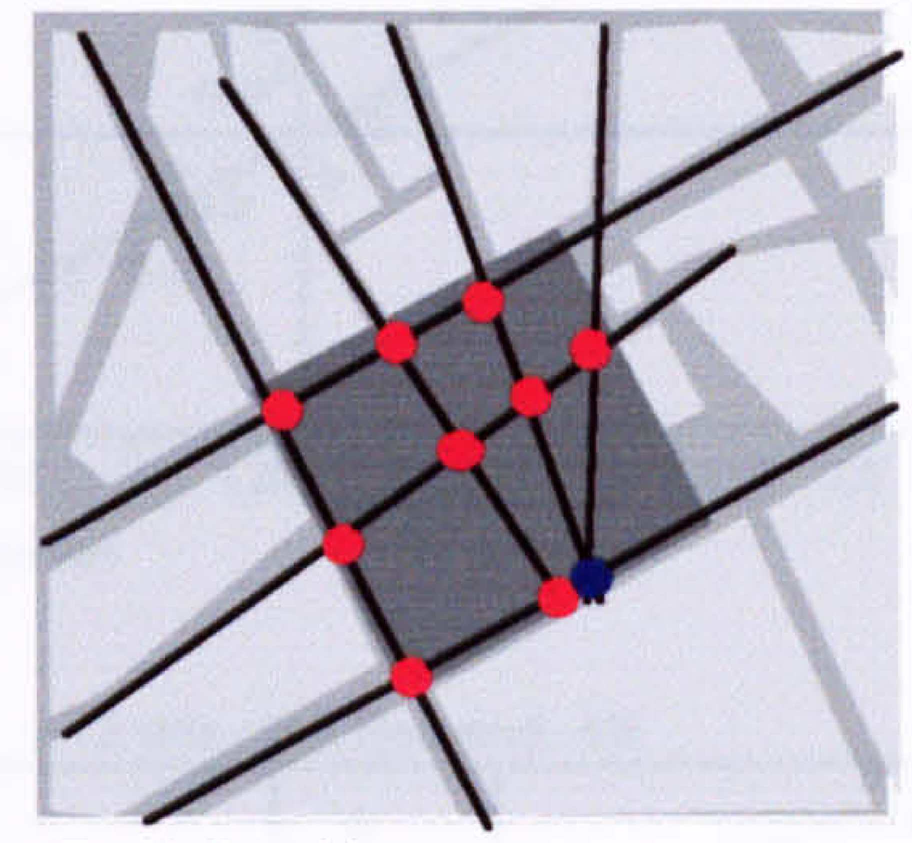


Fig. 21. Gyor - Hungary

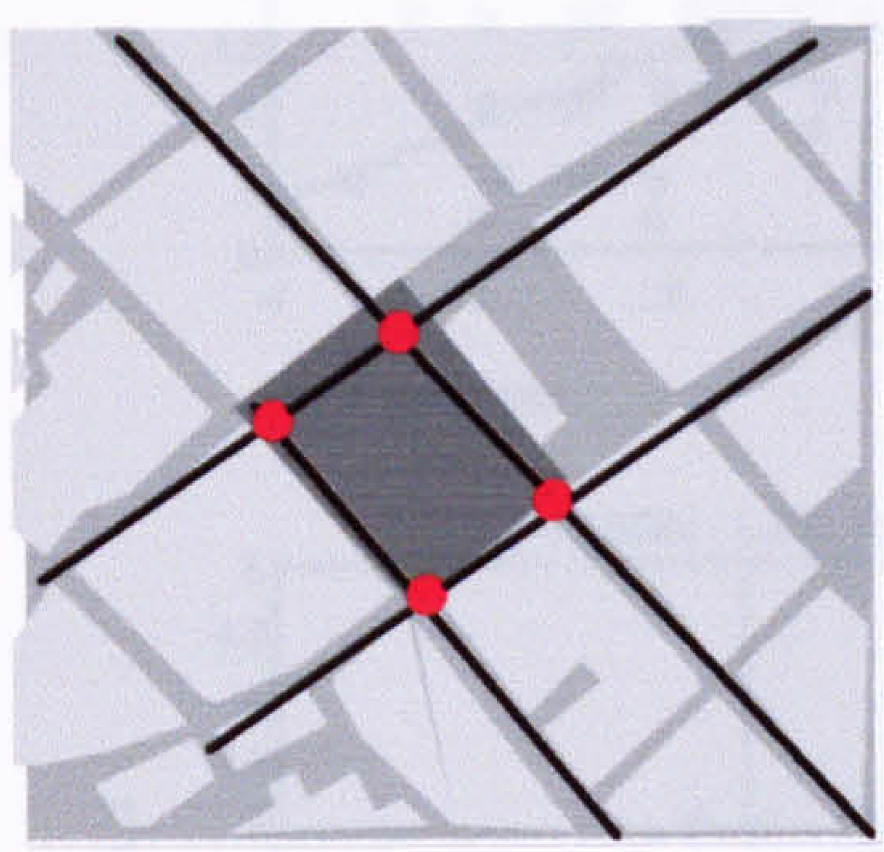


Fig. 22. Kalisz - Poland

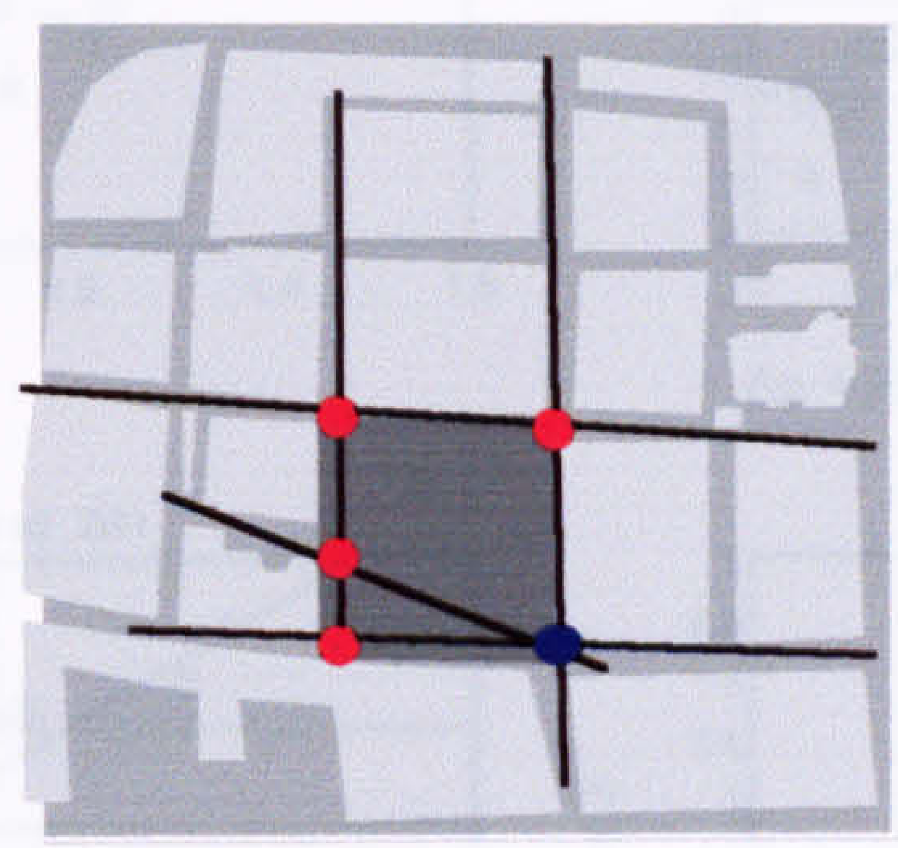


Fig. 23. Klatovy - Czech Republic

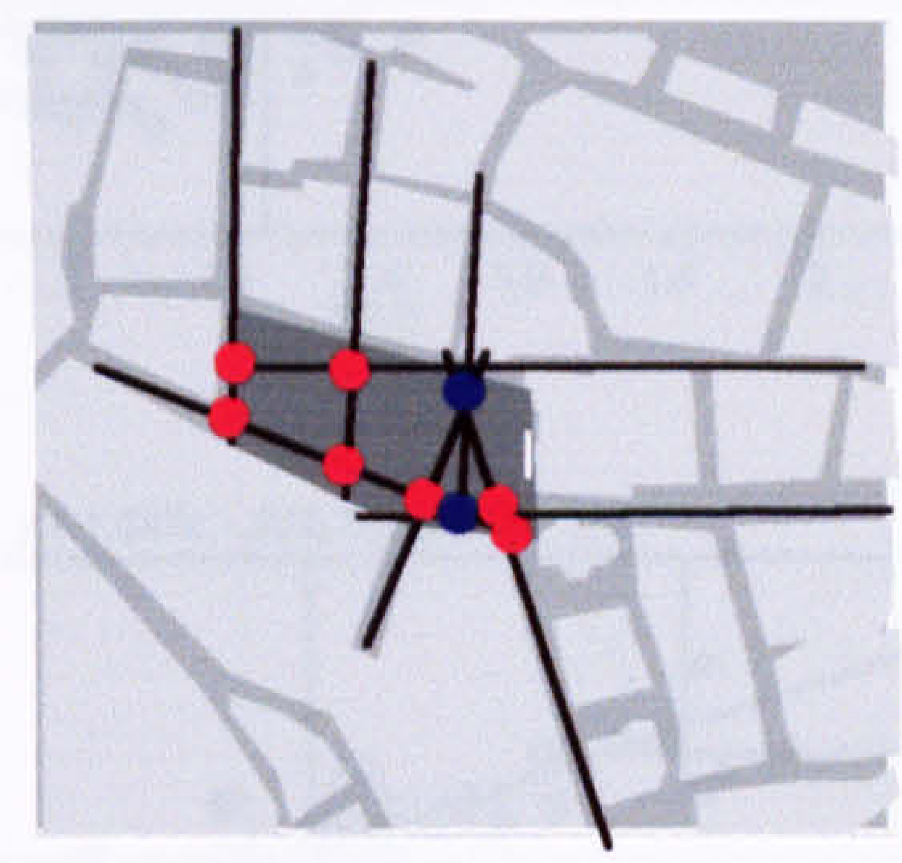


Fig. 24. Litomerice - Czech Republic

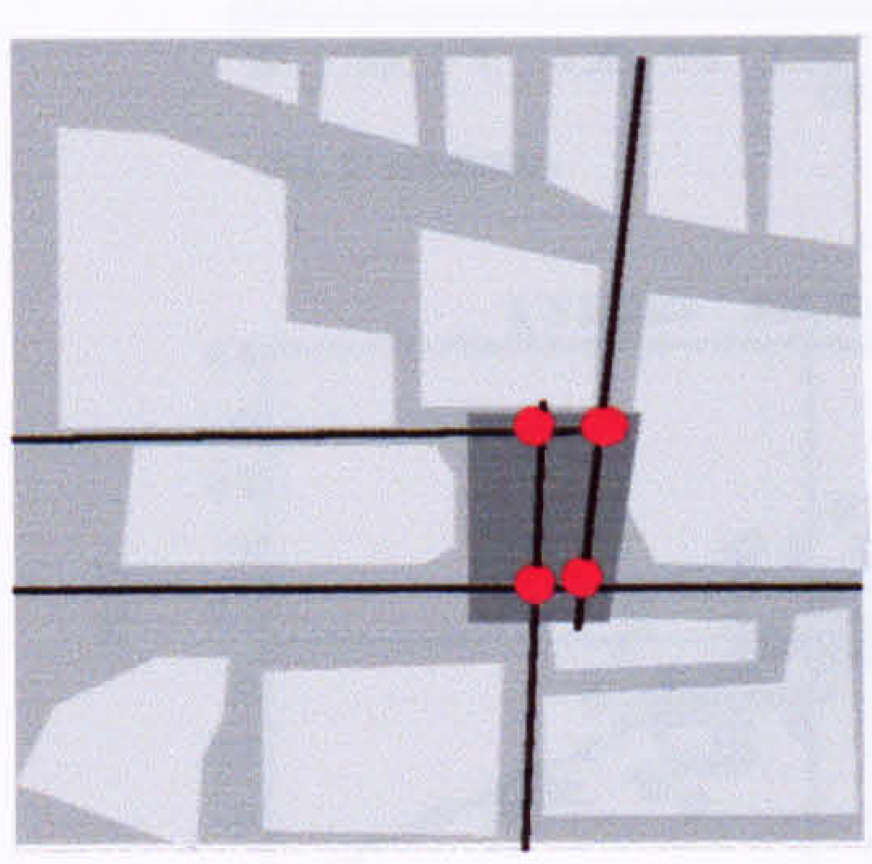


Fig. 25. Modena - Italy

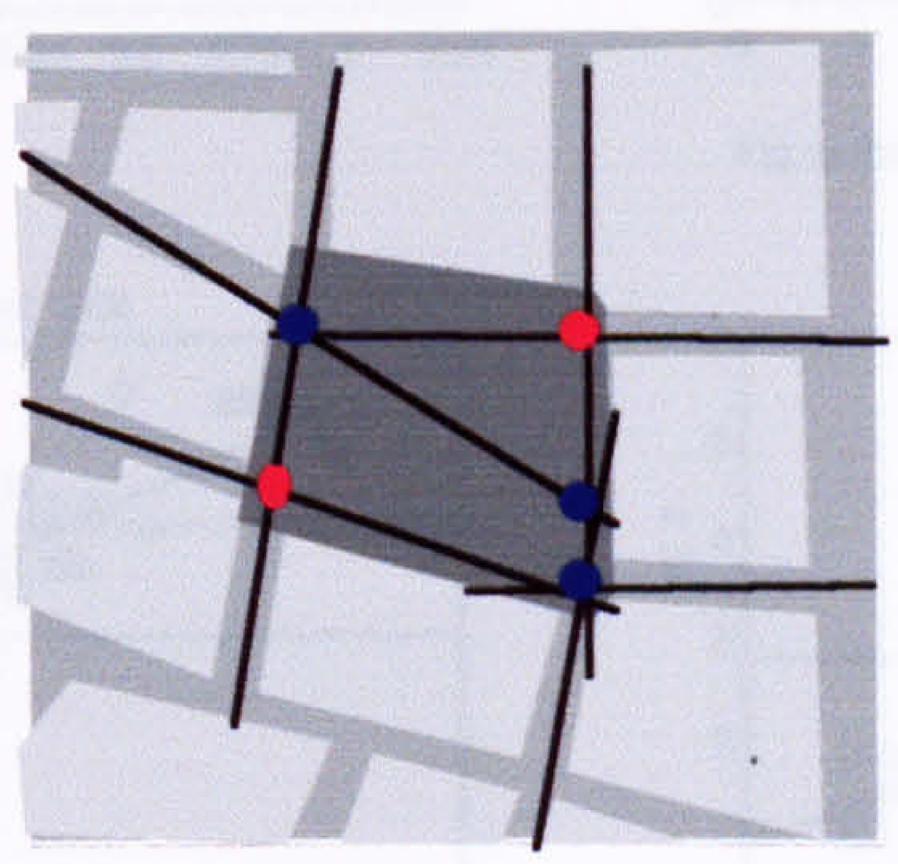


Fig. 26. Montauban - France

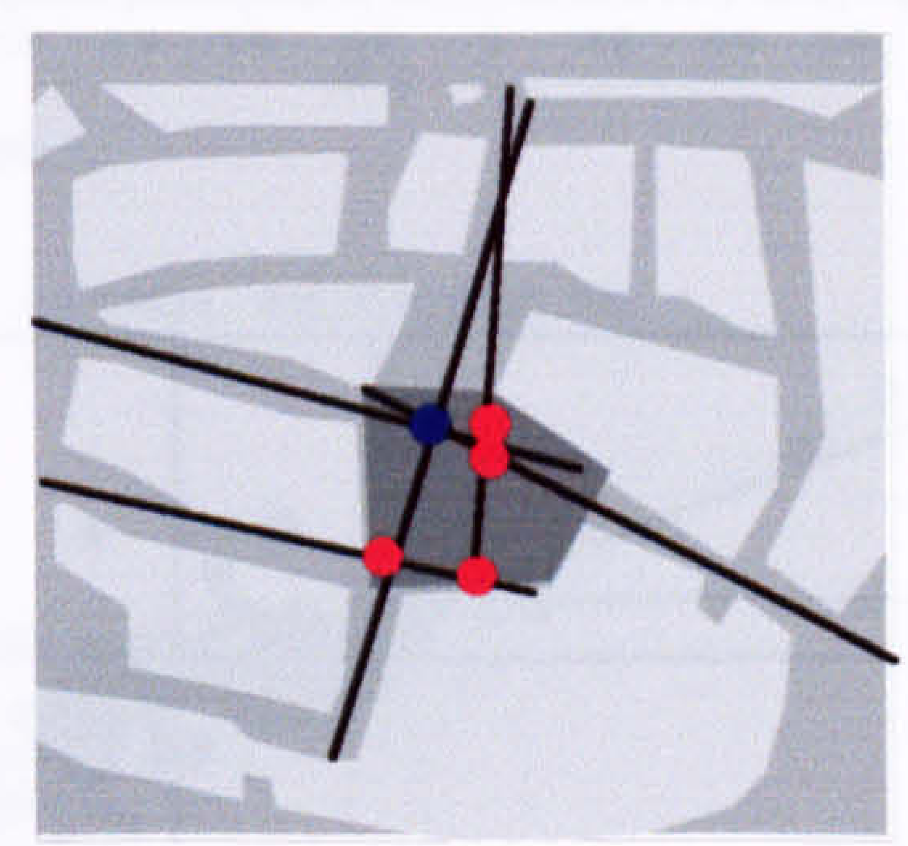


Fig. 27. Portalegre - Portugal

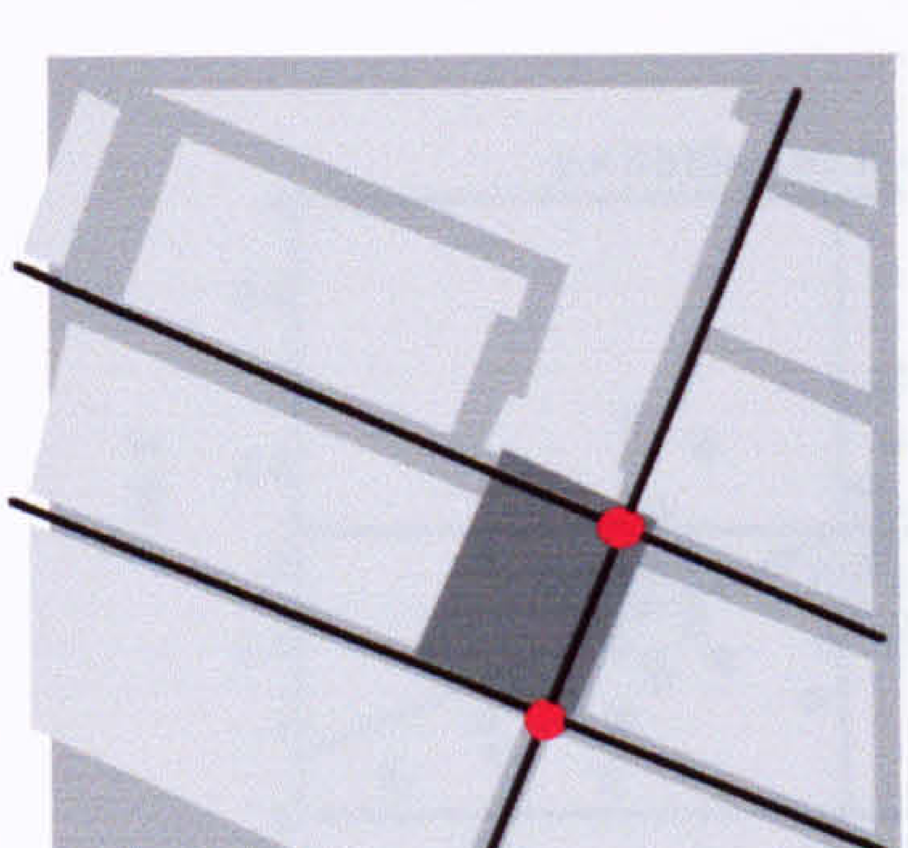


Fig. 28. Scarperia - Italy

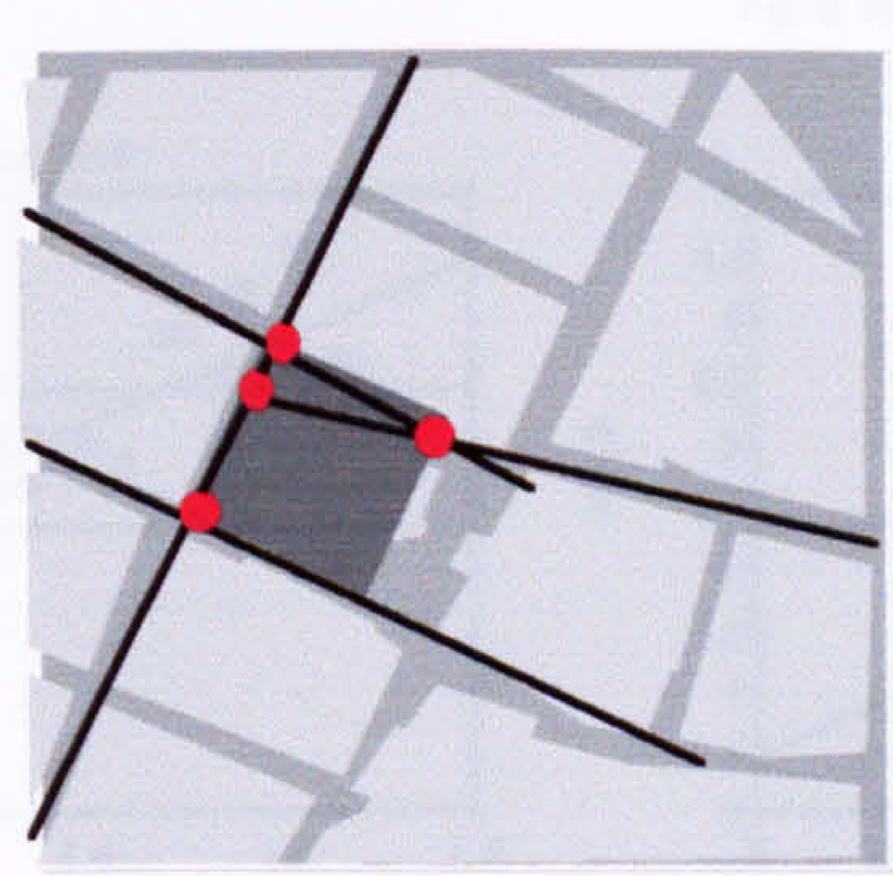


Fig. 29. Wielun - Poland

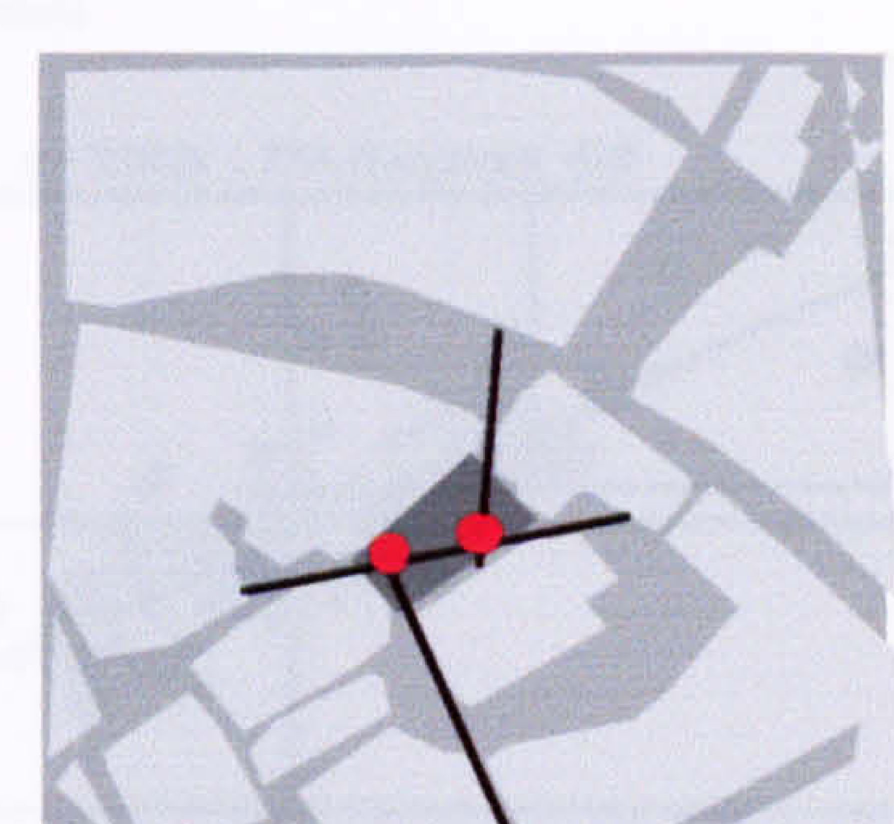


Fig. 30. Wolfsberg - Austria

Plate 3.9. Embedding scattergrams showing interfacing axial lines (1/3)

● interfacing axial lines

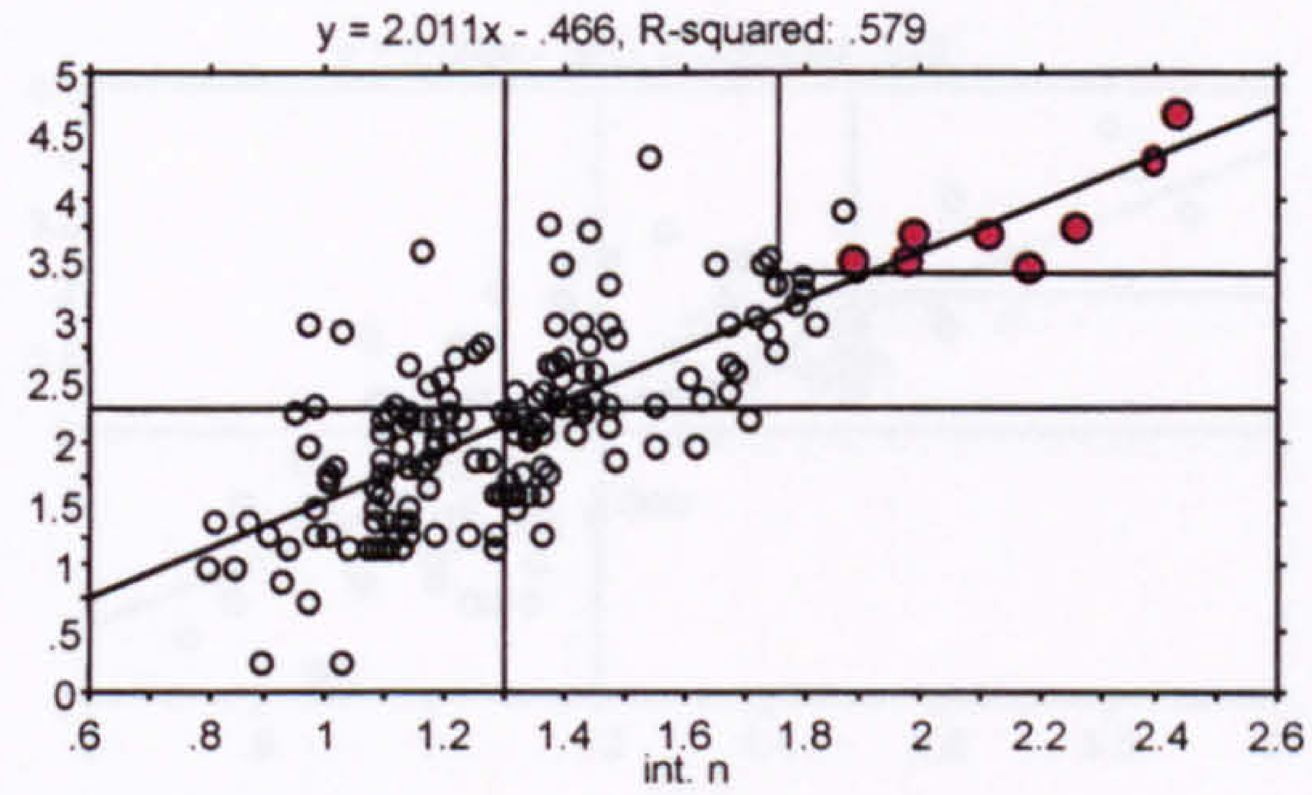


Fig. 1. Bruges

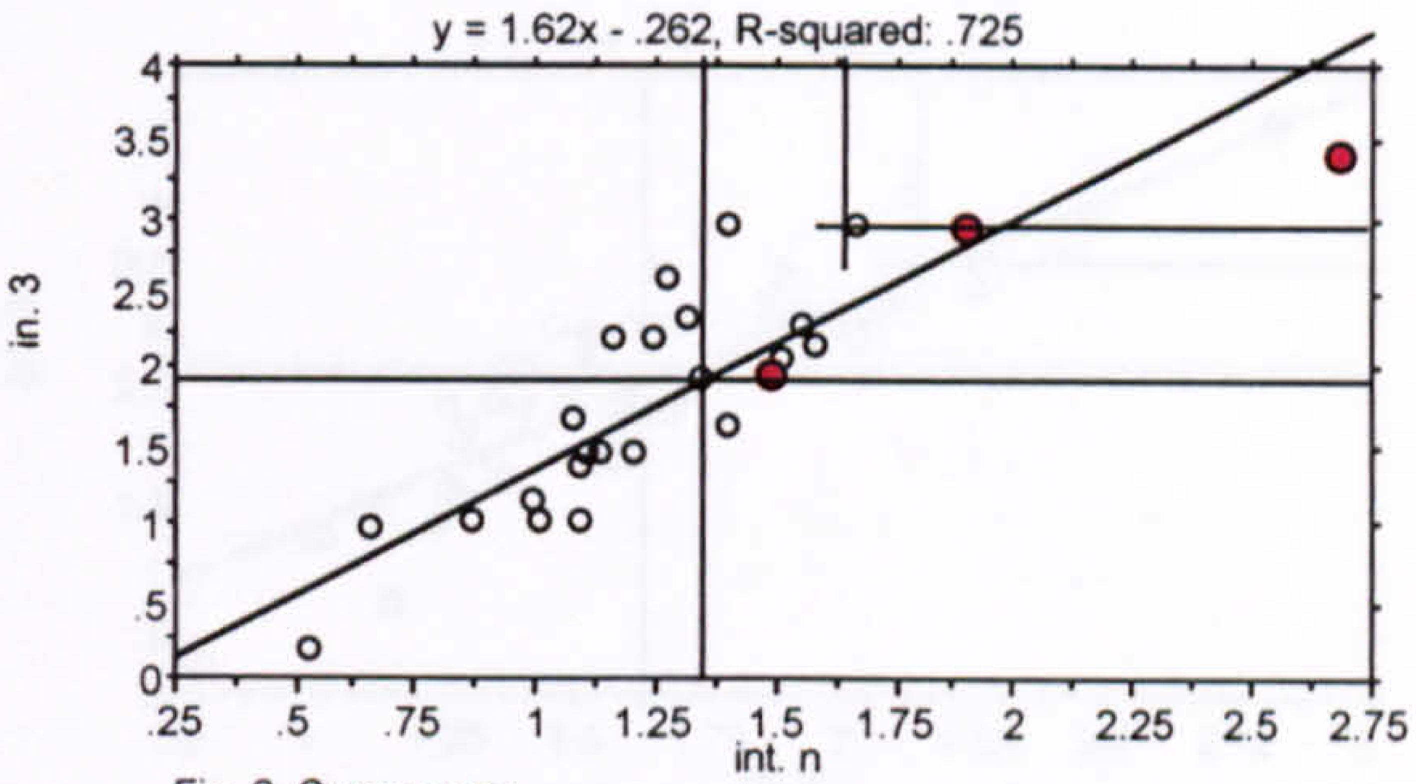


Fig. 2. Caernarvon

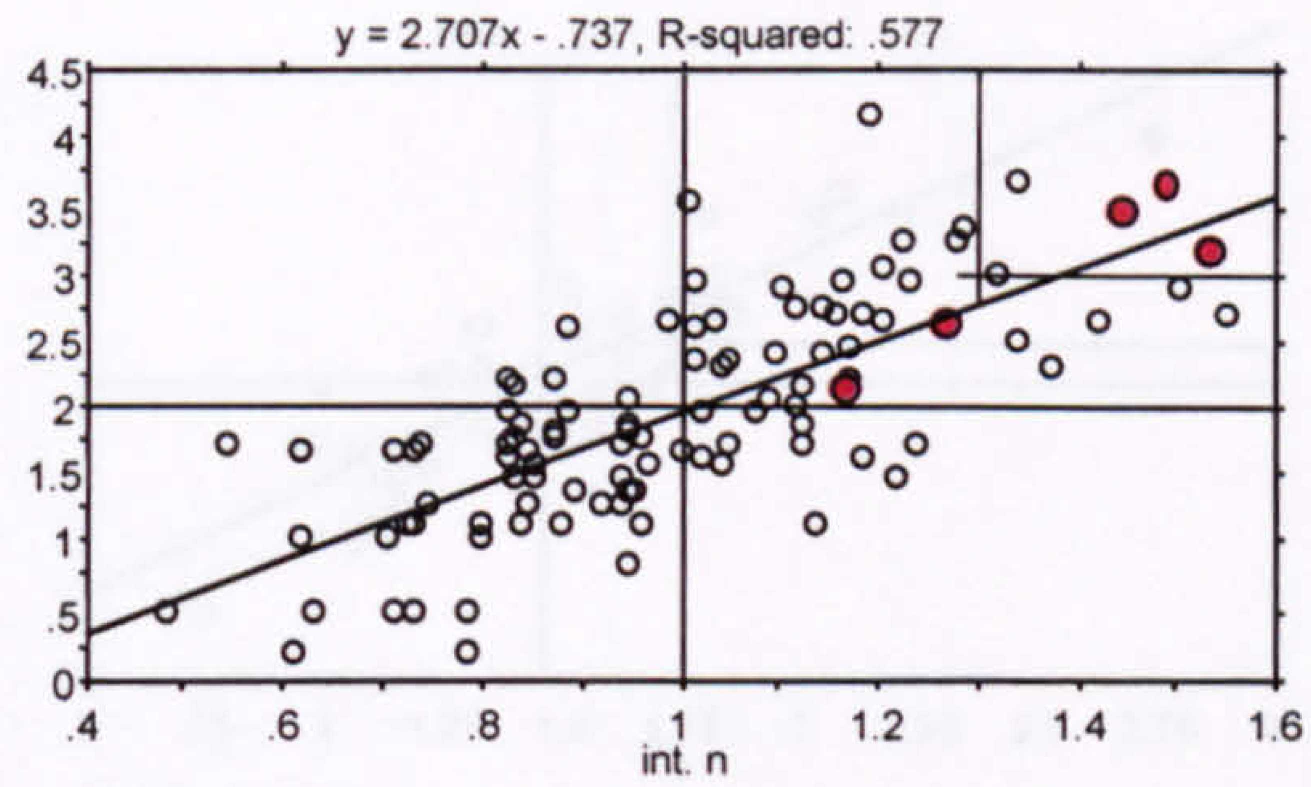


Fig. 3. Esslingen

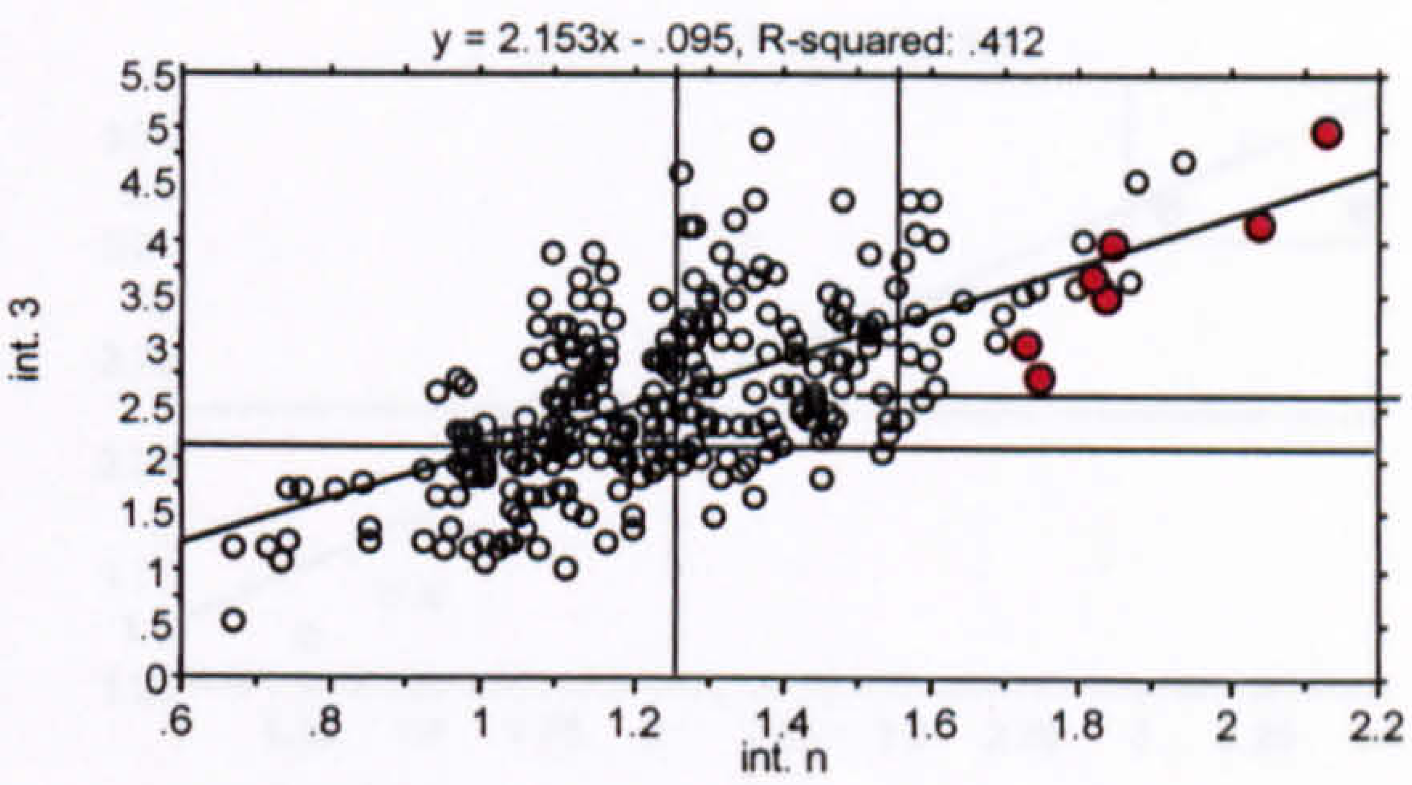


Fig. 4. Evora

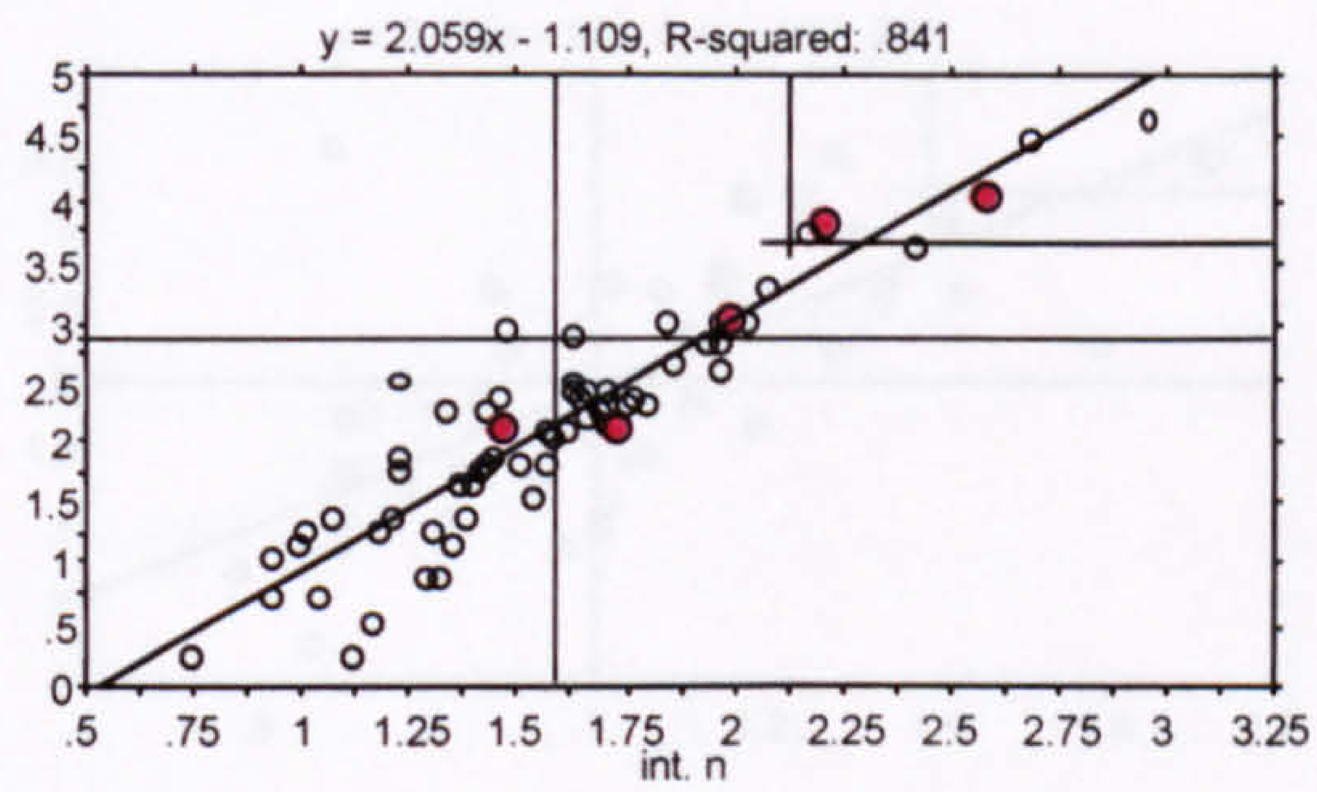


Fig. 5. Heilbronn

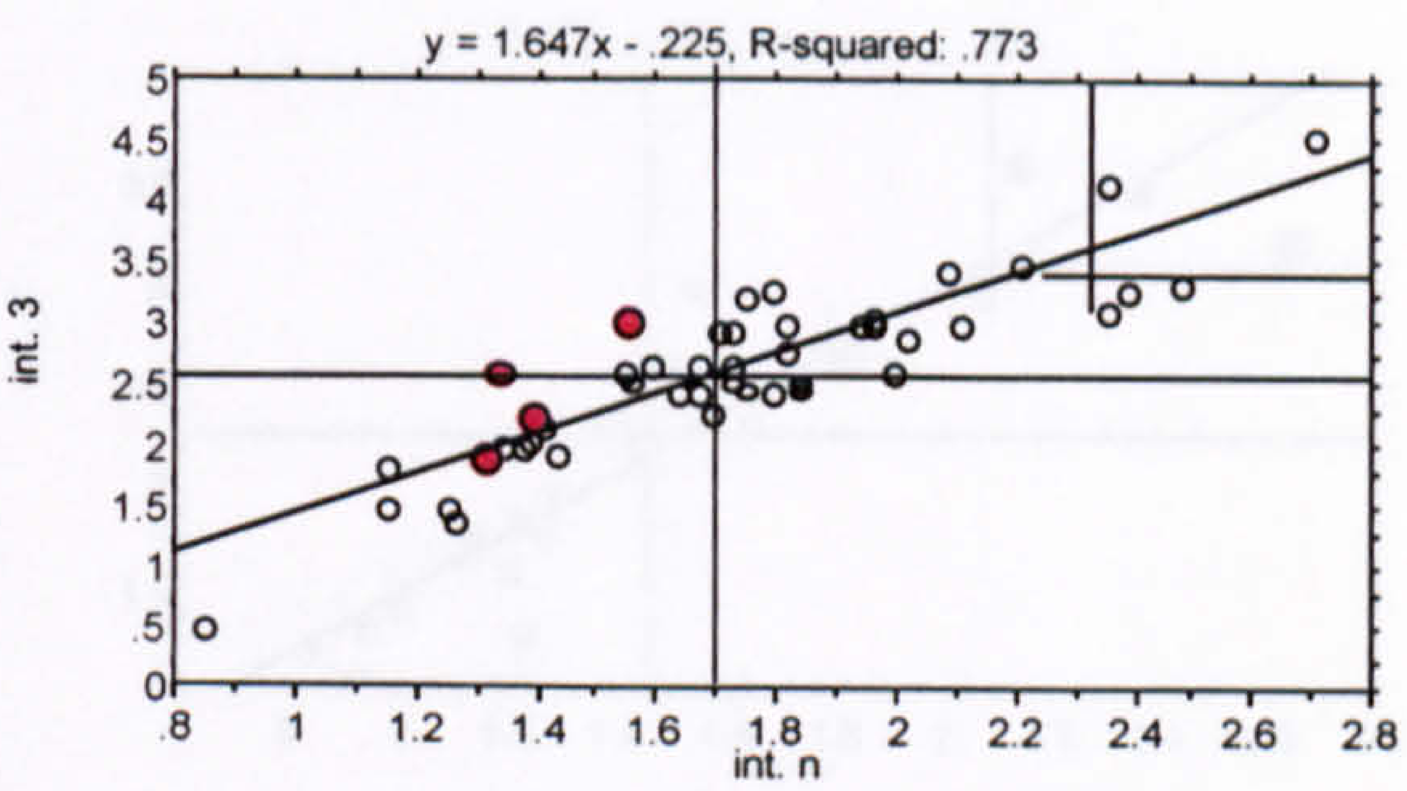


Fig. 6. Kempten

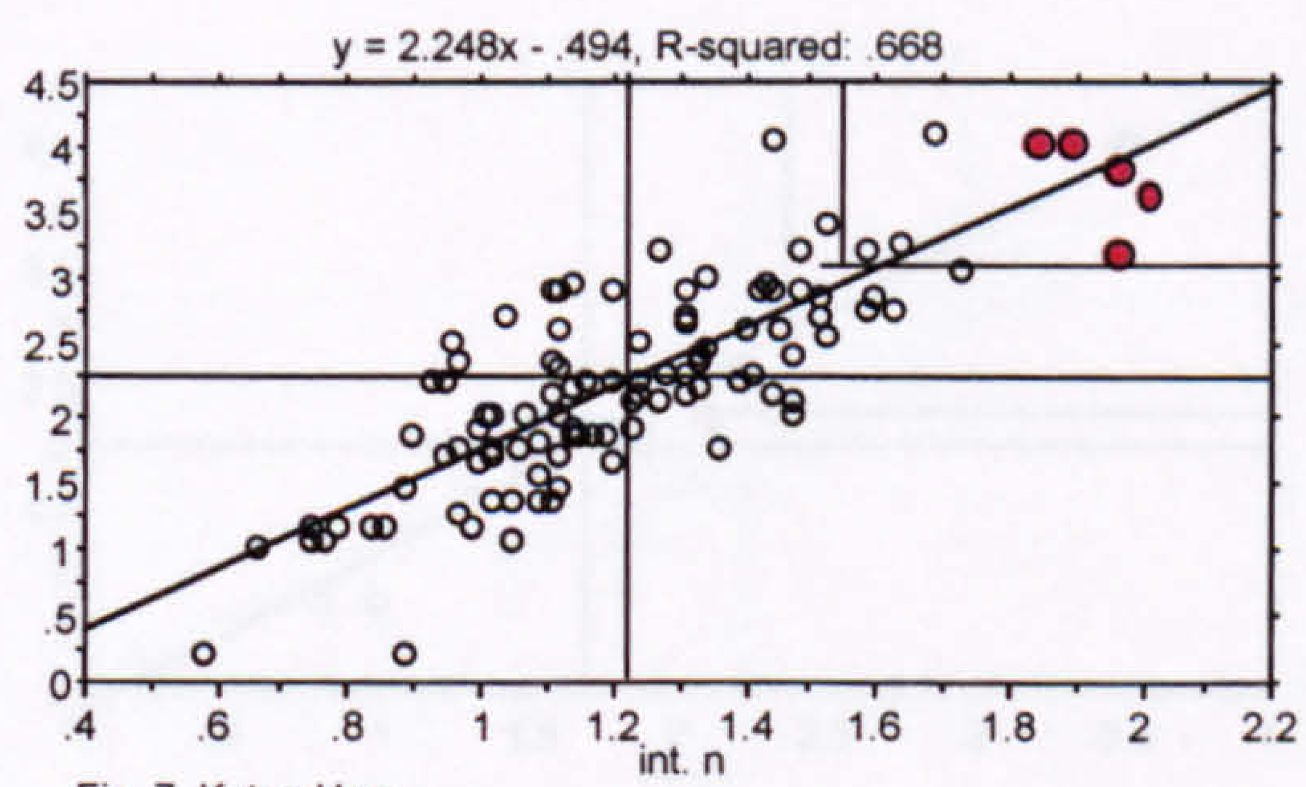


Fig. 7. Kutna Hora

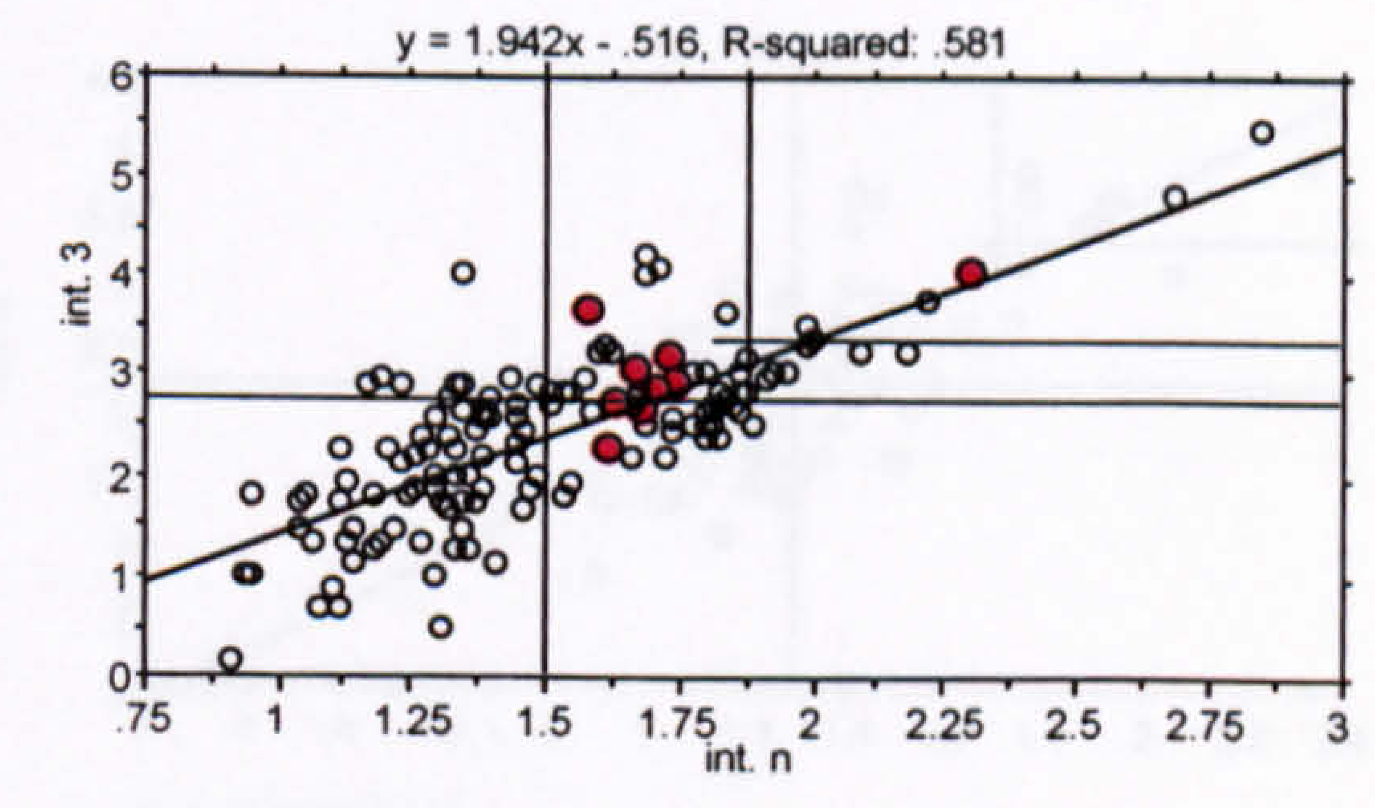


Fig. 8. Magdeburg

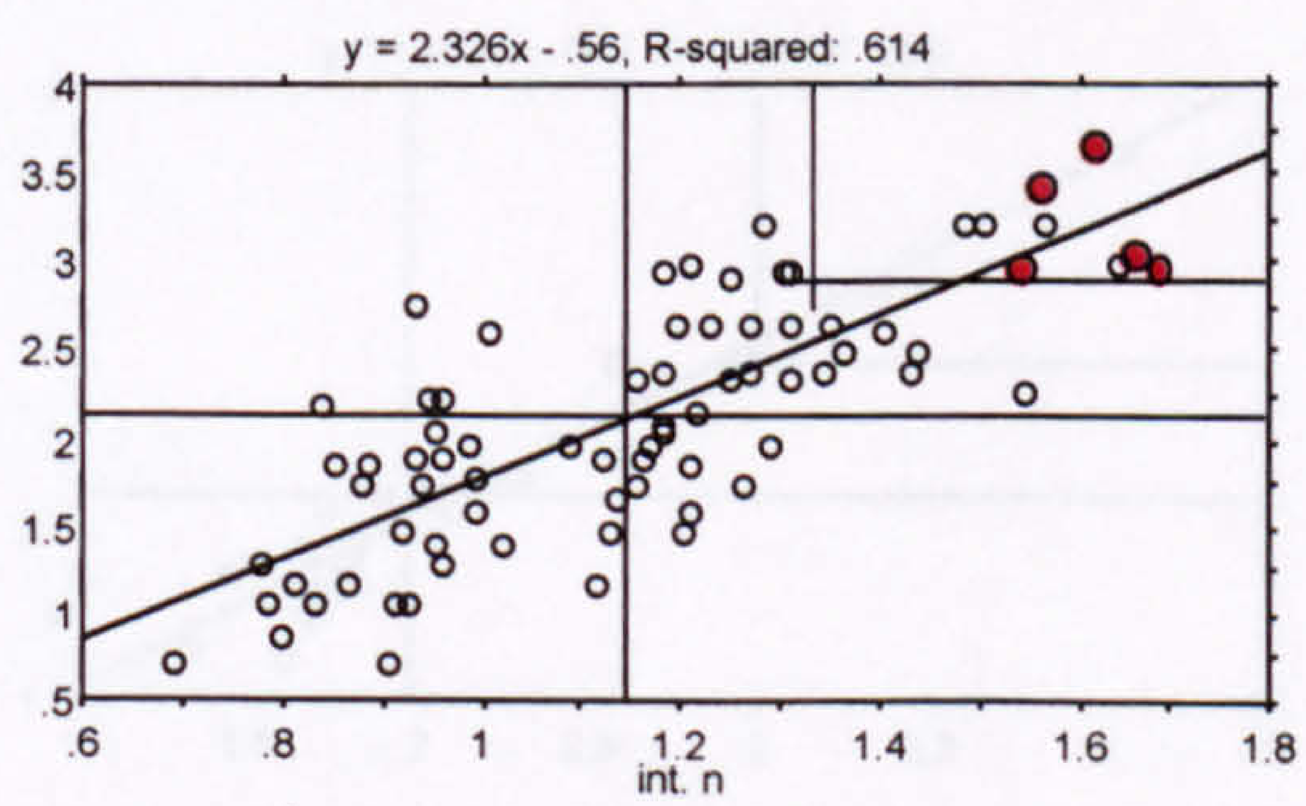


Fig. 9. Moguer

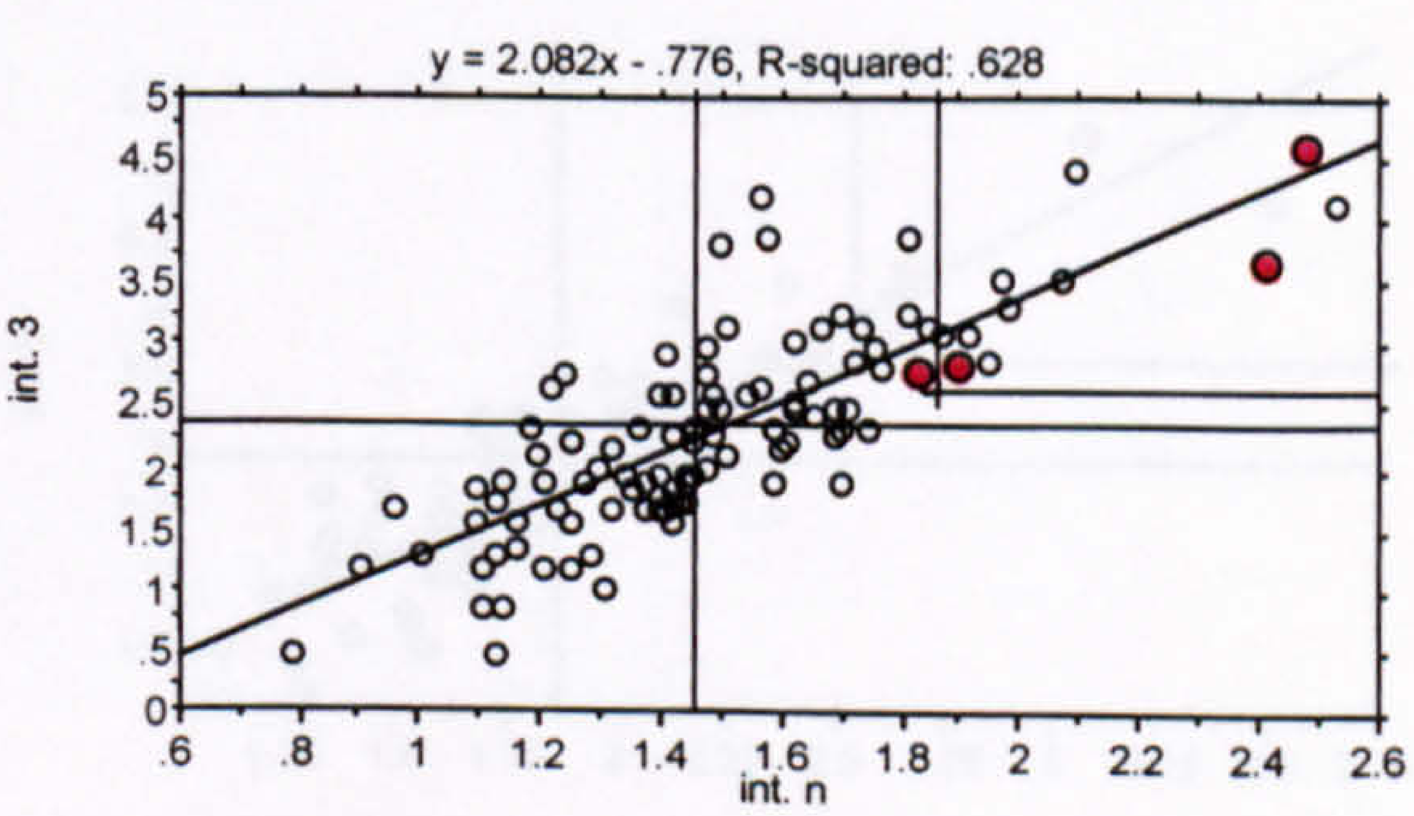


Fig. 10. Nijmegen

Plate 3.9. Embedding scattergrams showing interfacing axial lines (2/3)

● interfacing axial lines

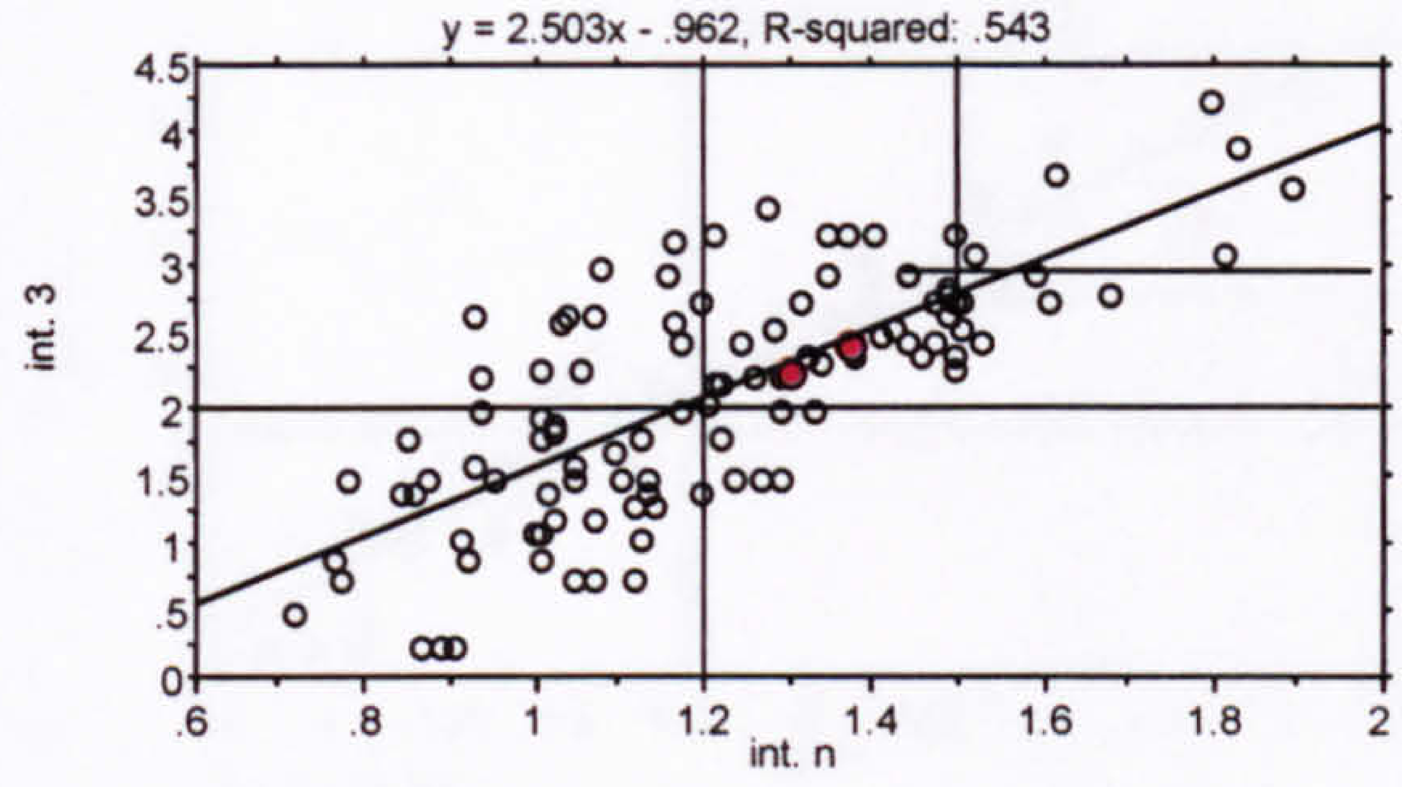


Fig. 11. Palencia

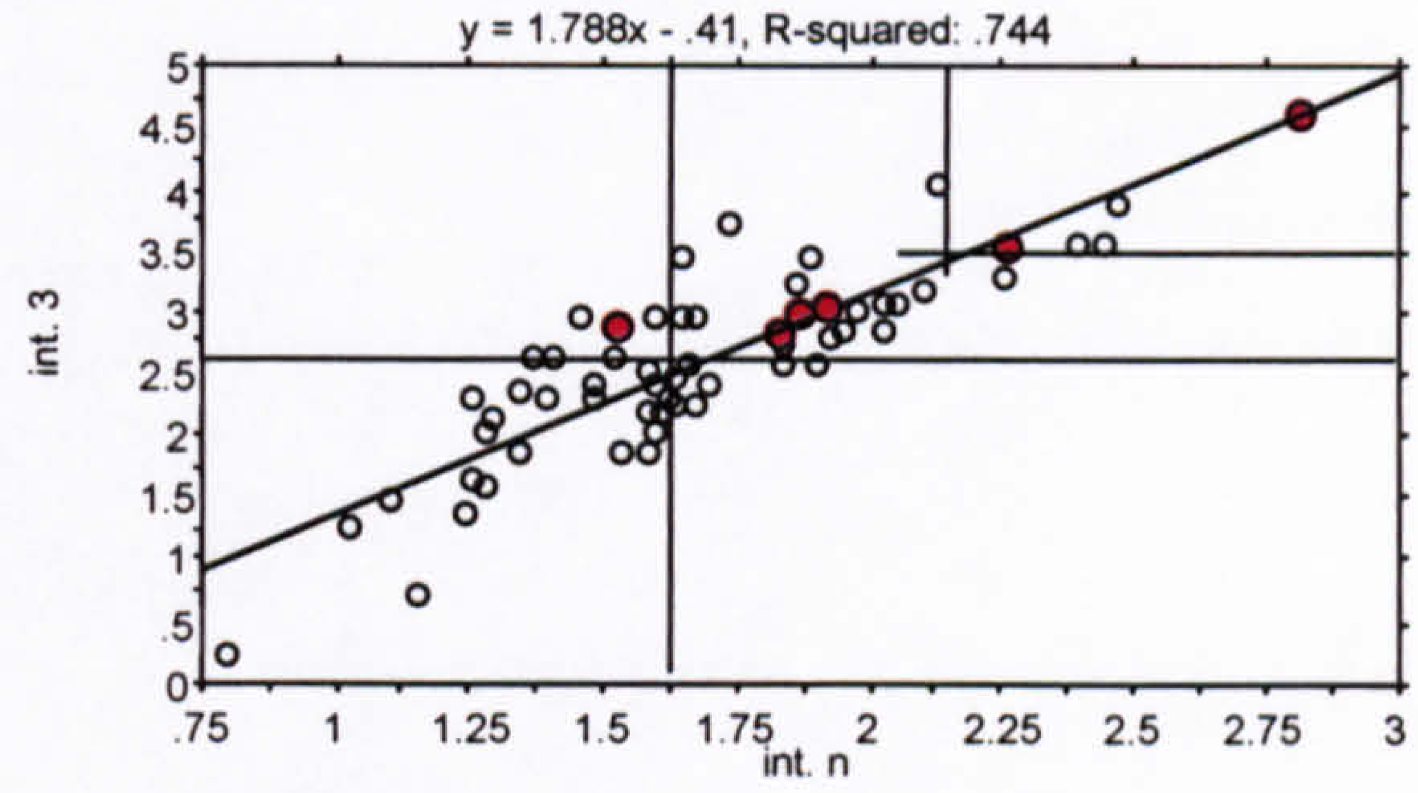


Fig. 12. Pest

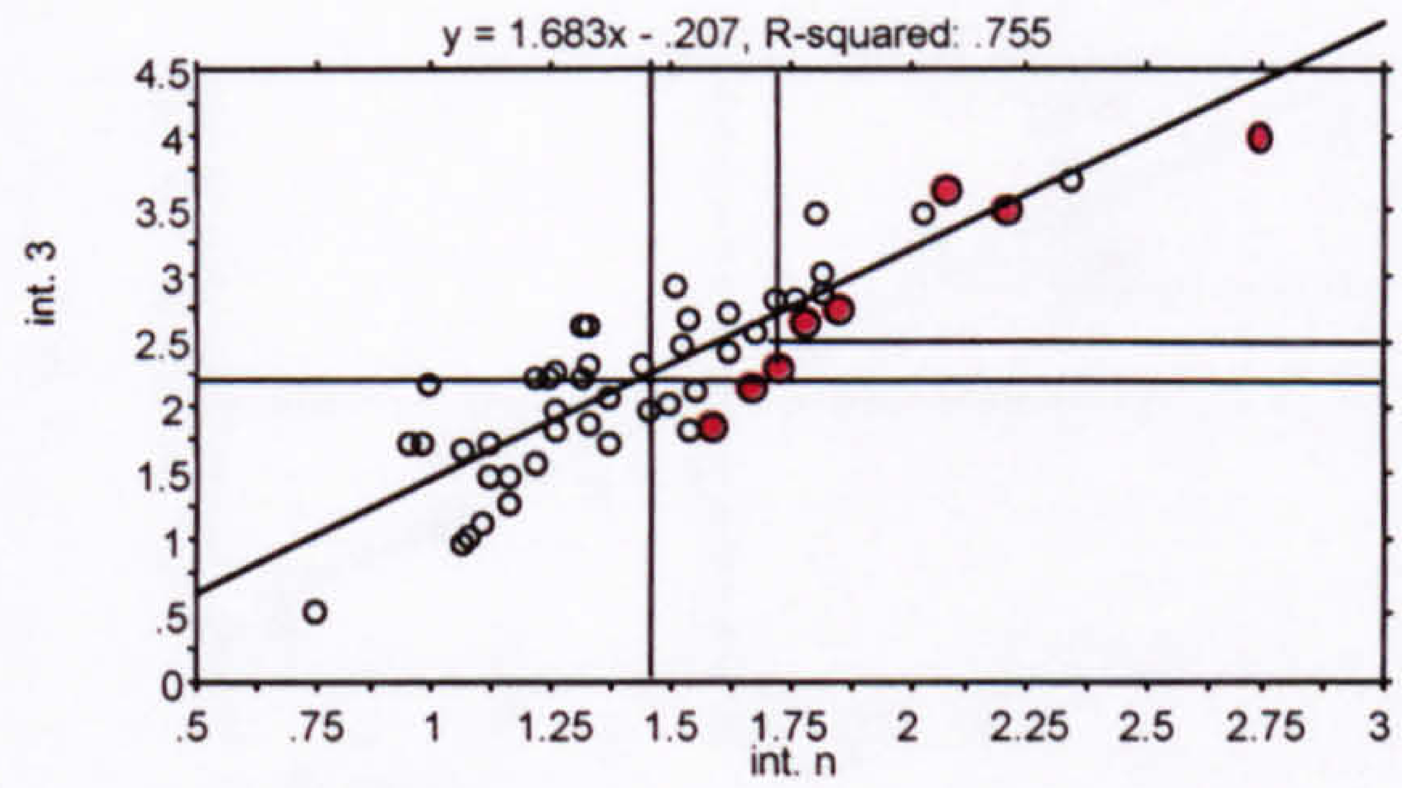


Fig. 13. San Gimignano

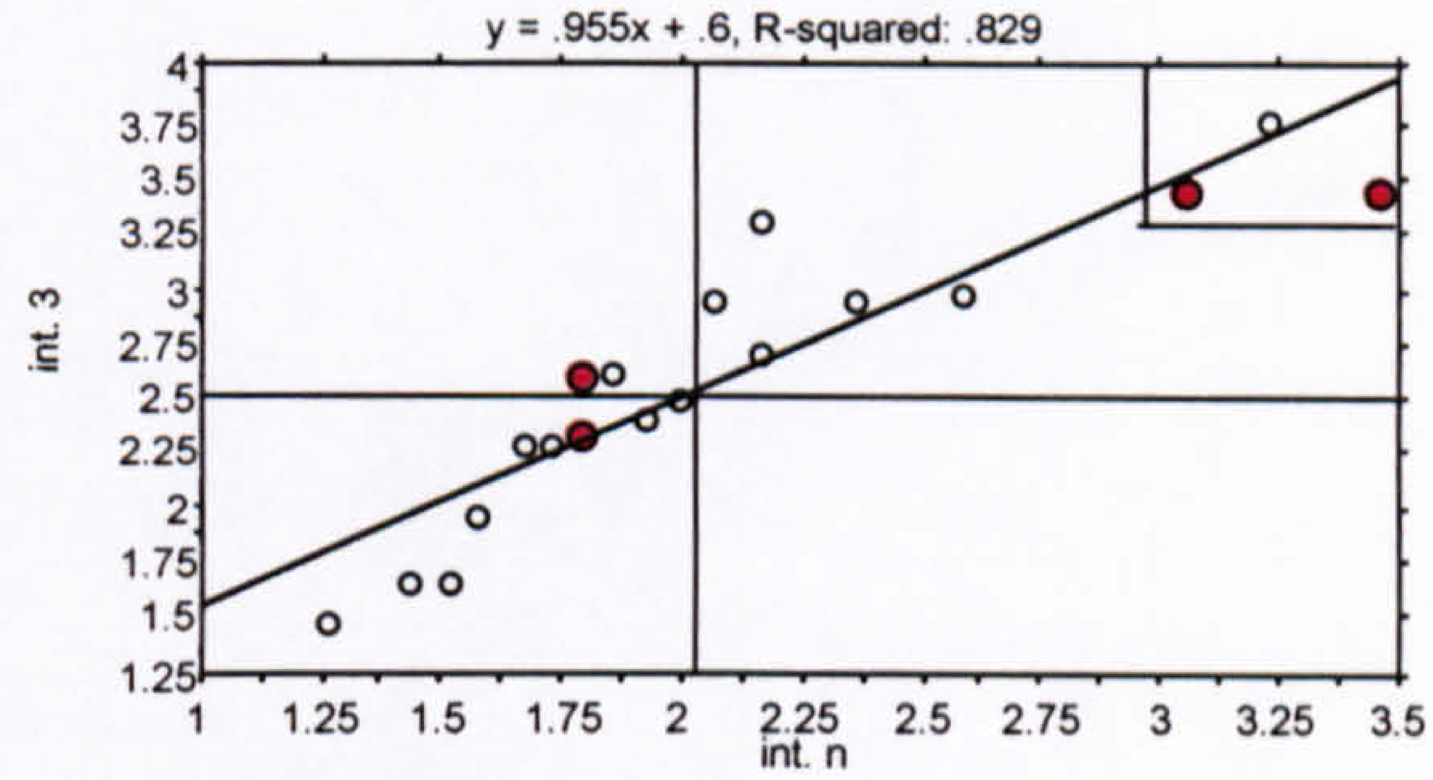


Fig. 14. Salisbury

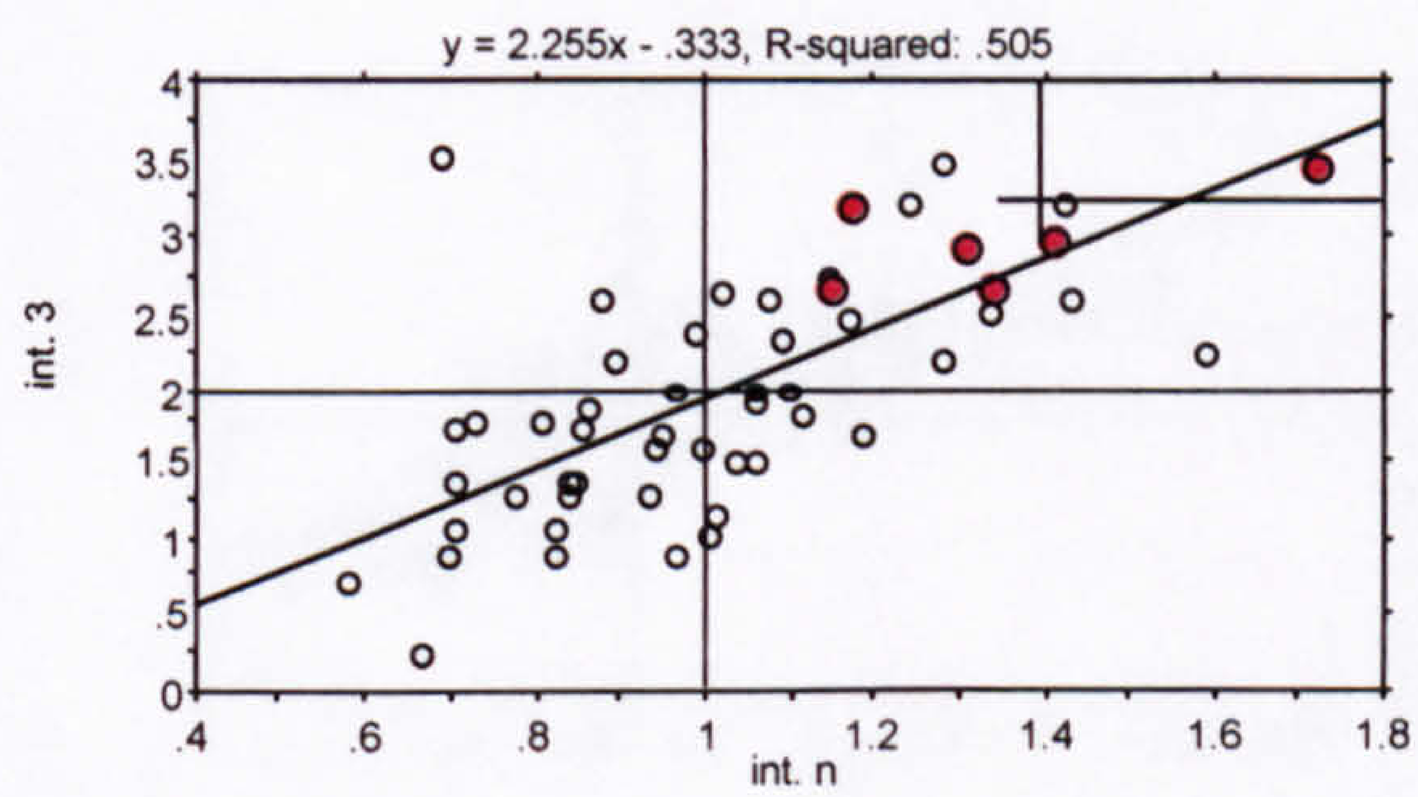


Fig. 15. Verdun

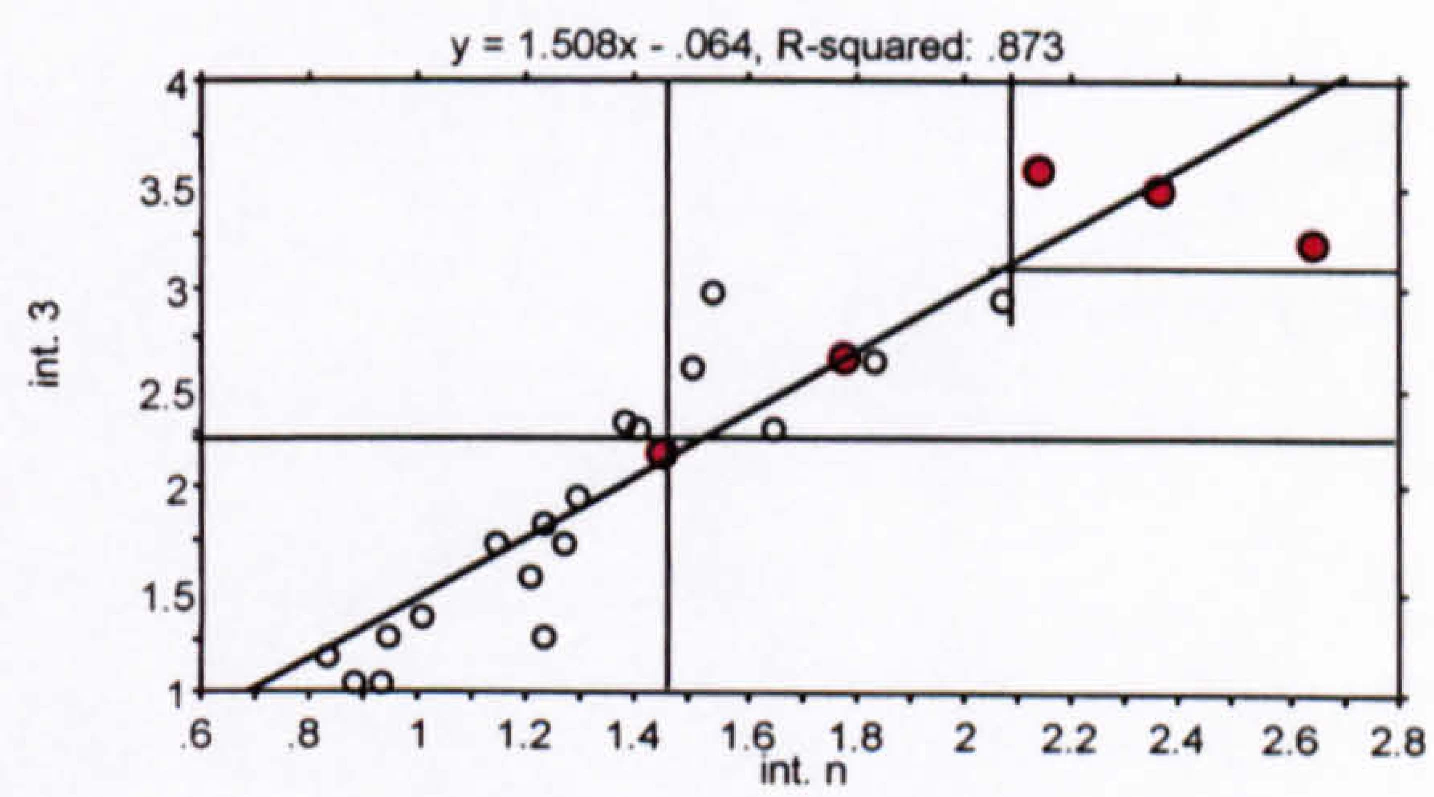


Fig. 16. Volkermarkt

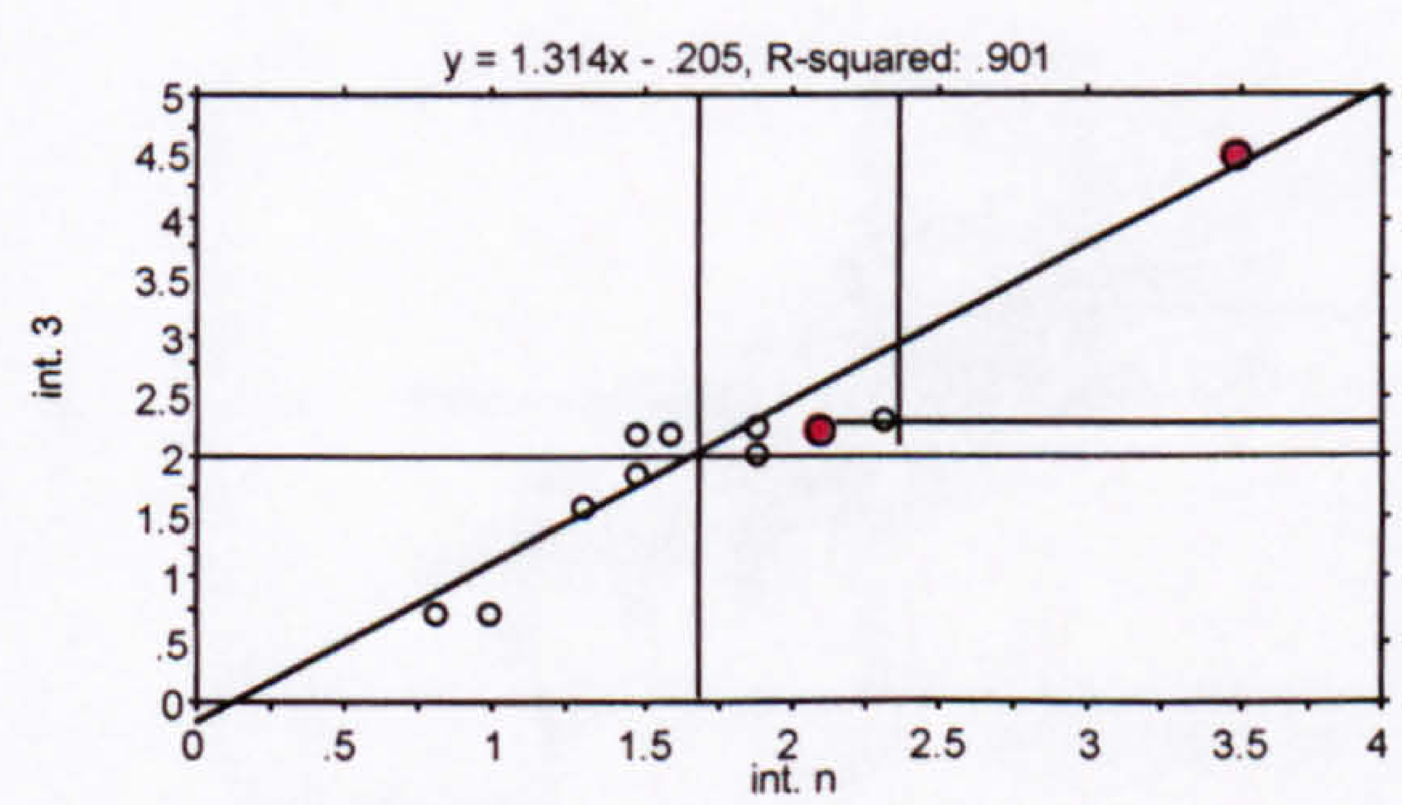


Fig. 17. Borgomanero

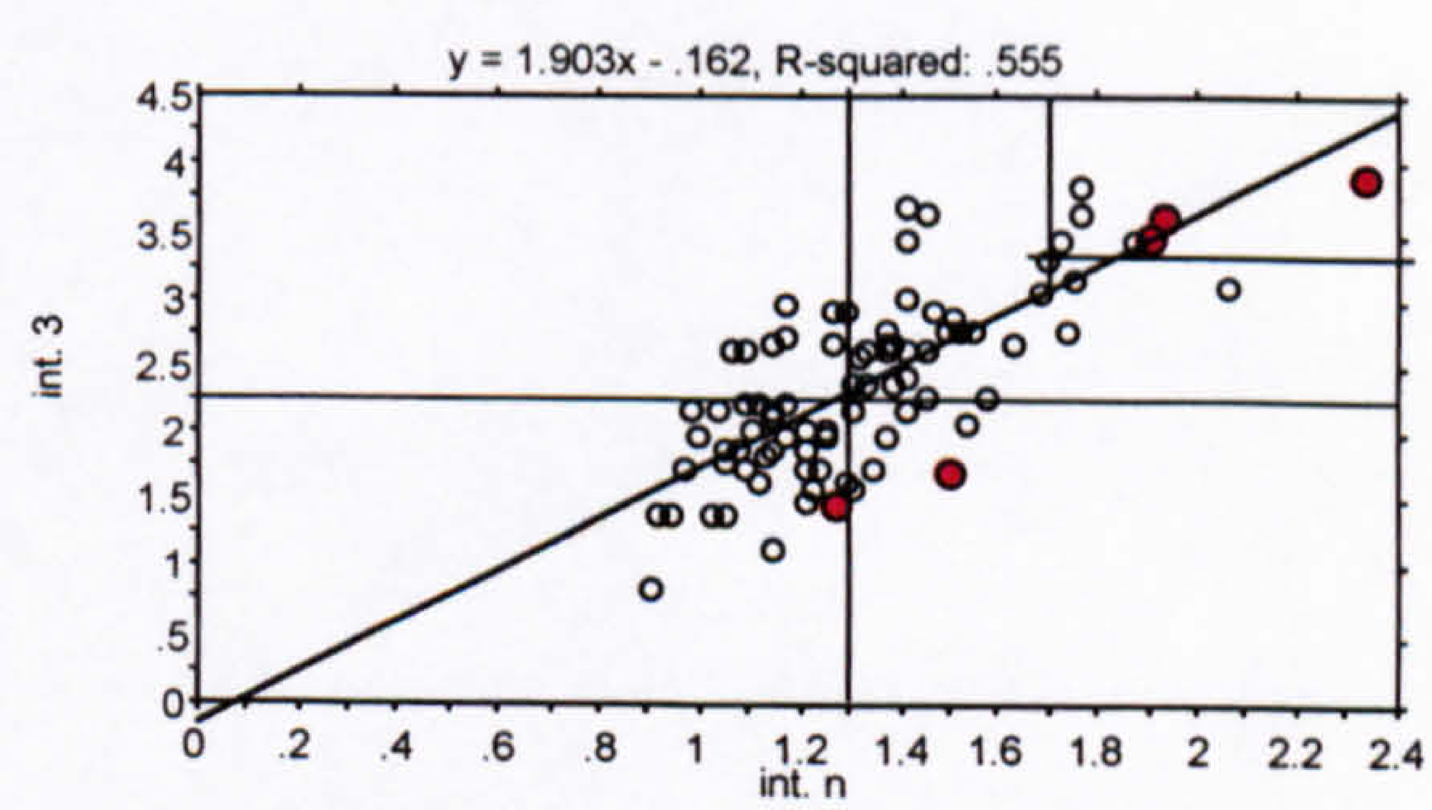


Fig. 18. Brive

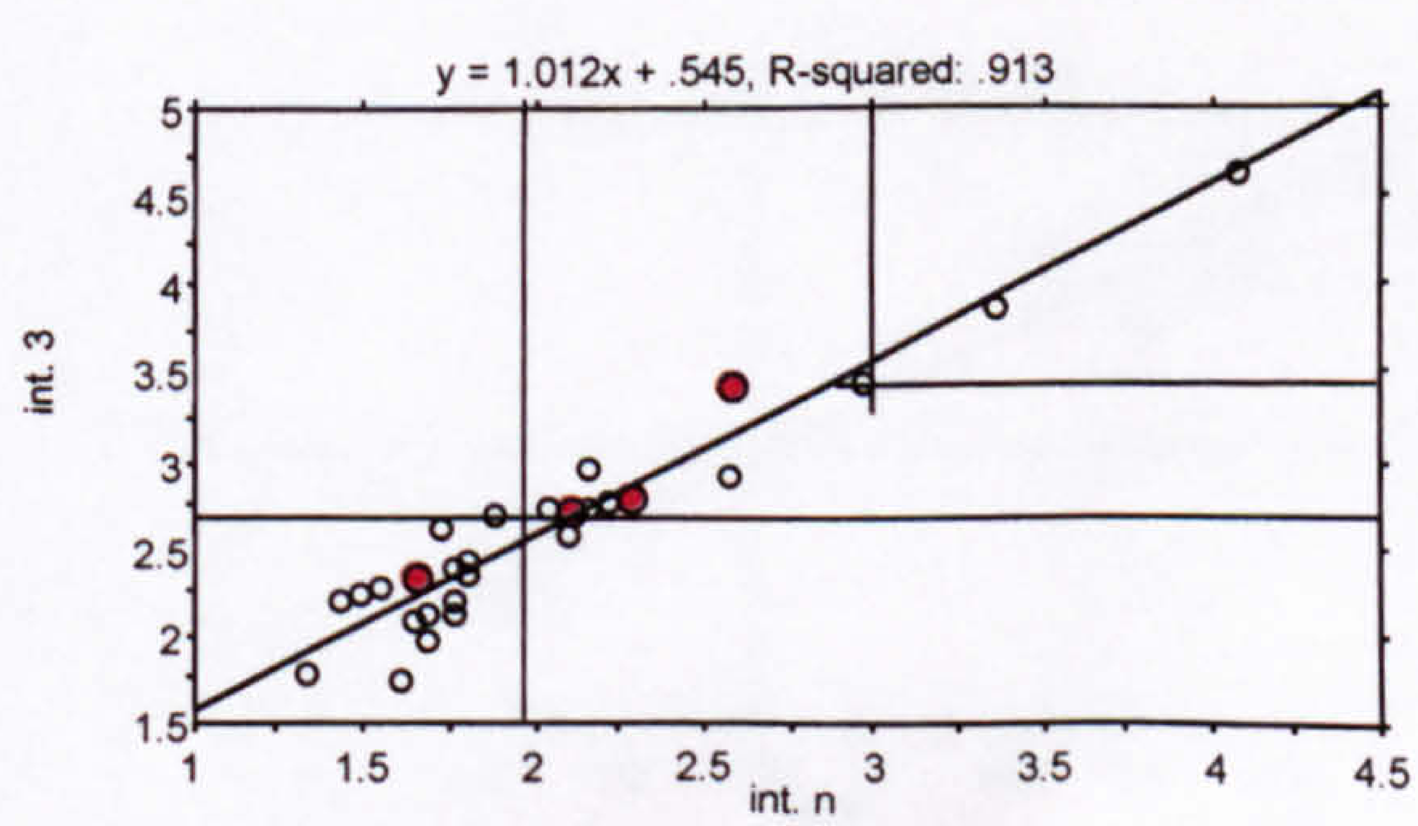


Fig. 19. Castellon de la Plana

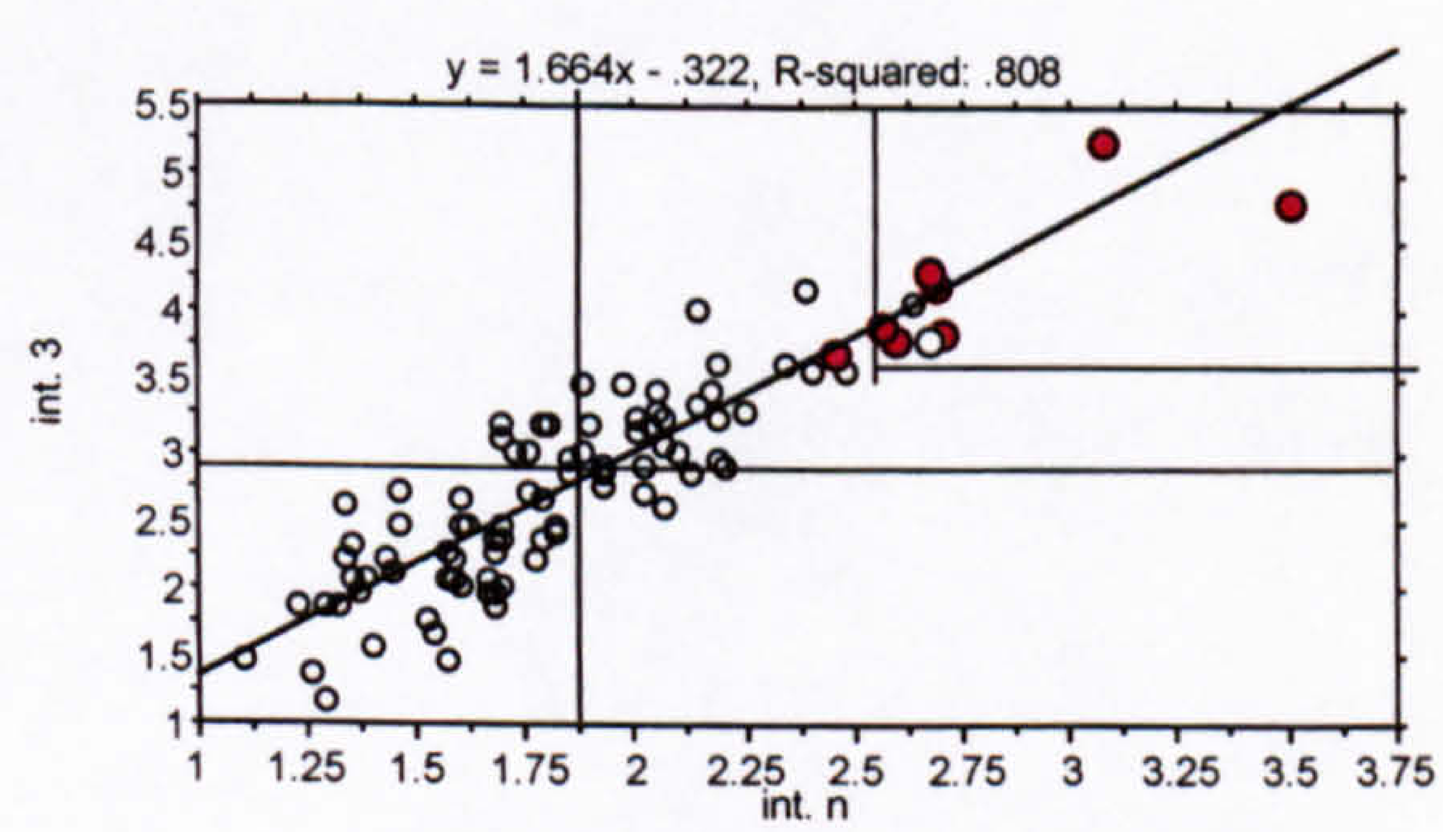


Fig. 20. Groningen

Plate 3.9. Embedding scattergrams showing interfacing axial lines (3/3)

● interfacing axial lines

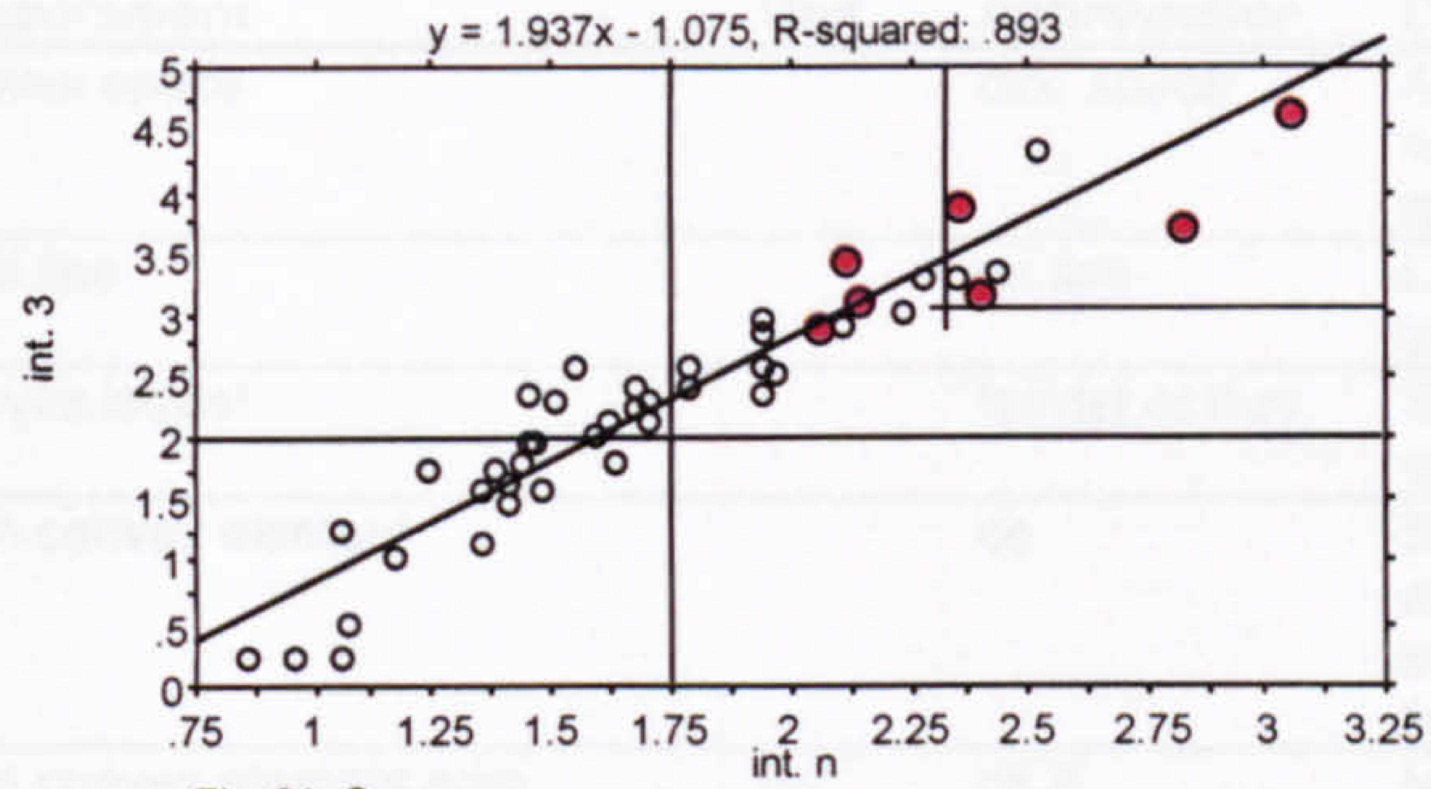


Fig. 21. Gyor

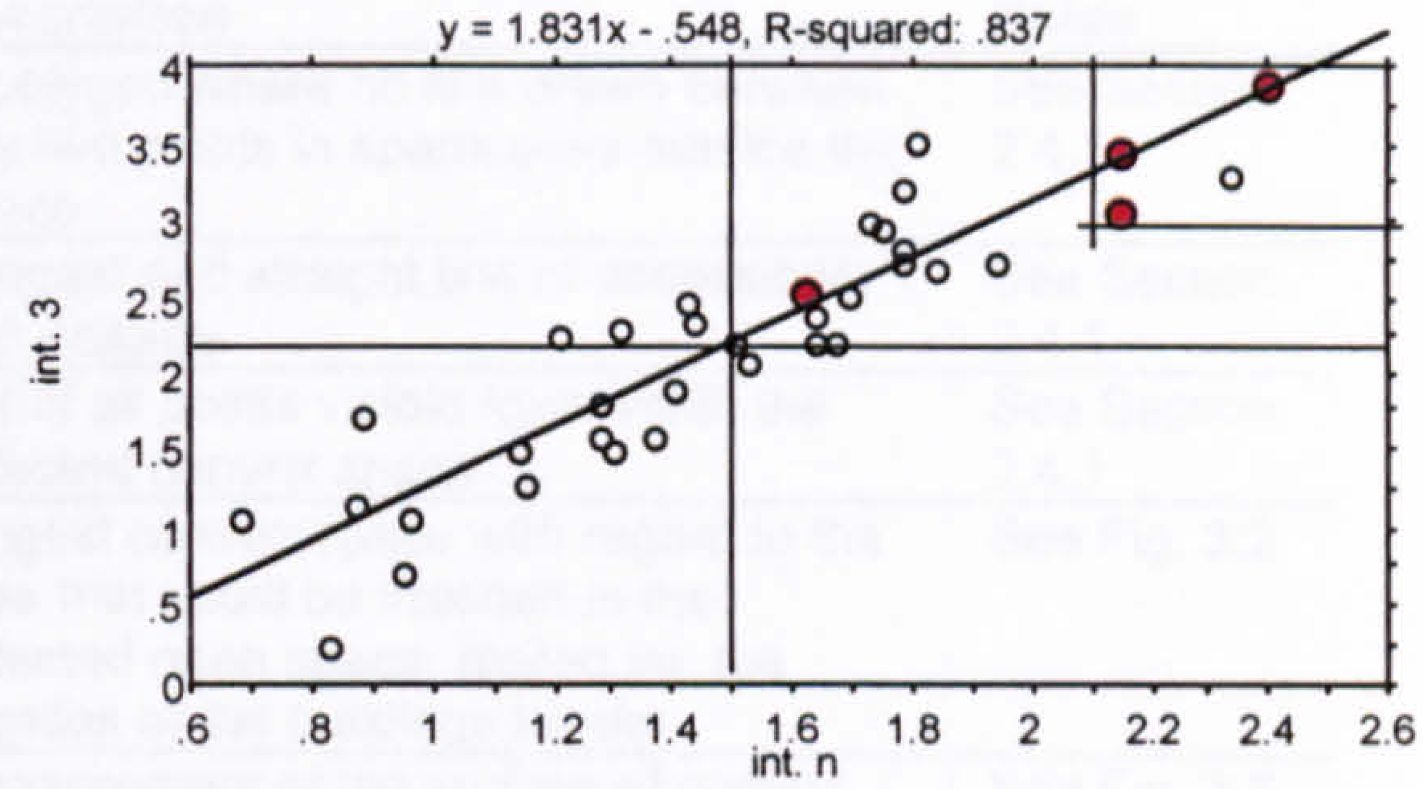


Fig. 22. Kalisz

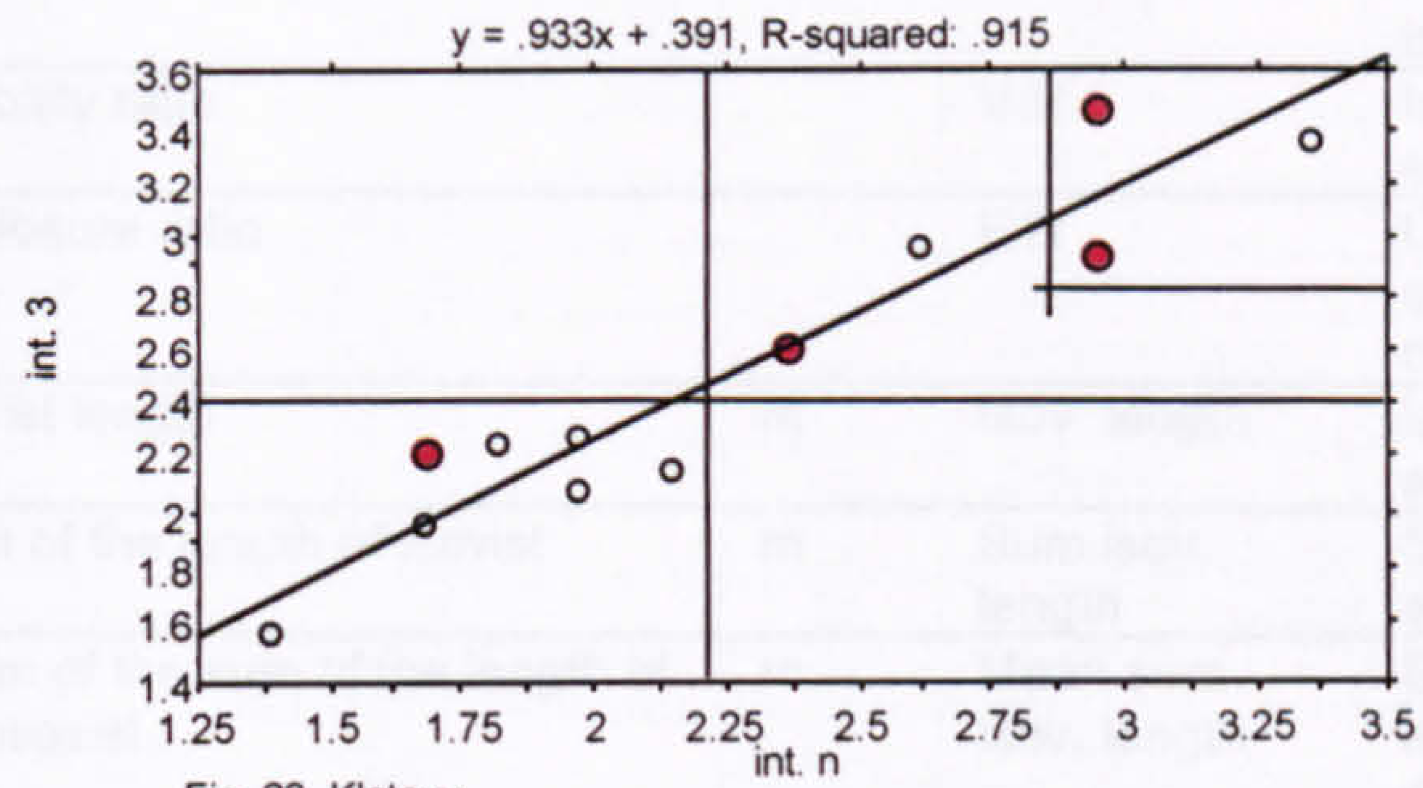


Fig. 23. Klatovy

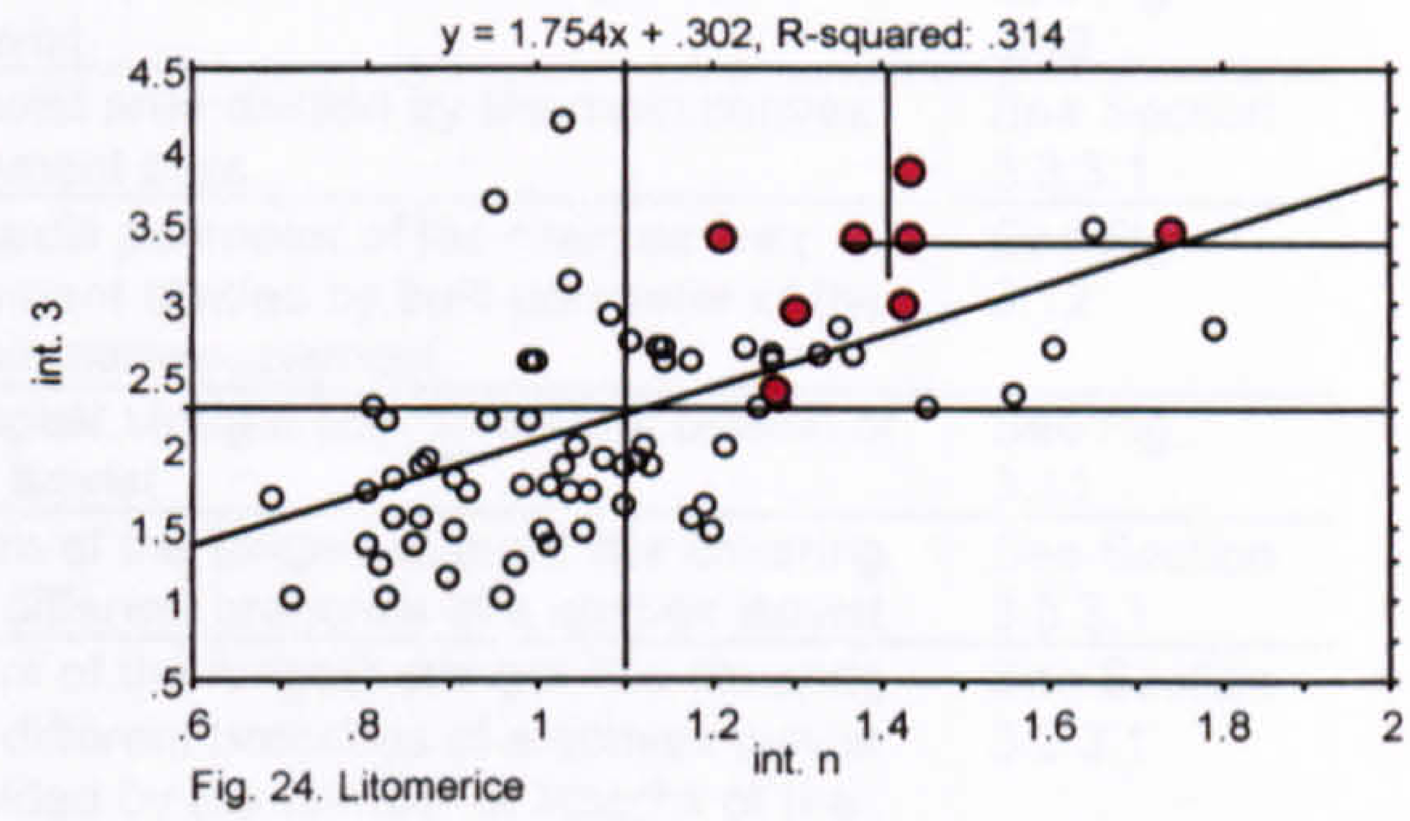


Fig. 24. Litomerice

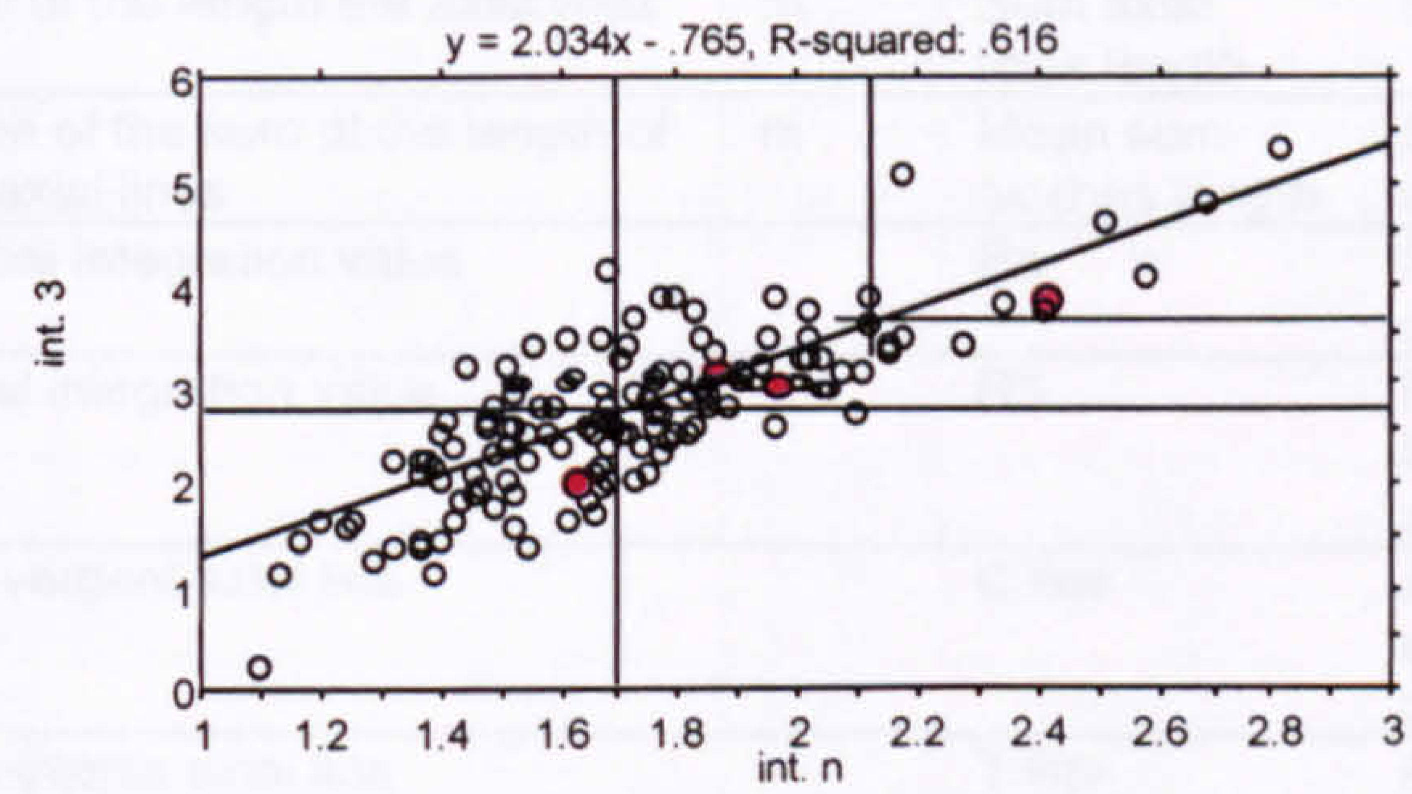


Fig. 25. Modena

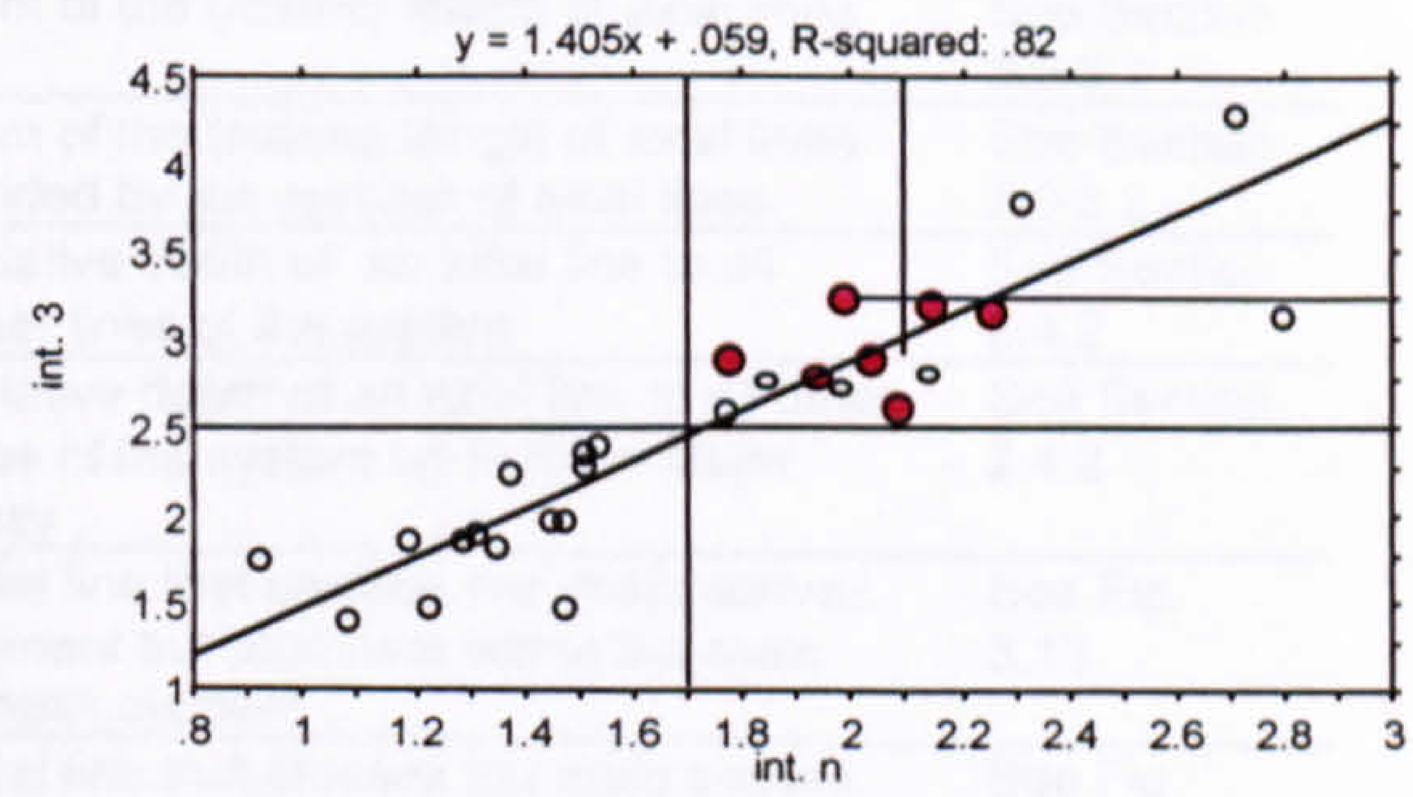


Fig. 26. Montauban

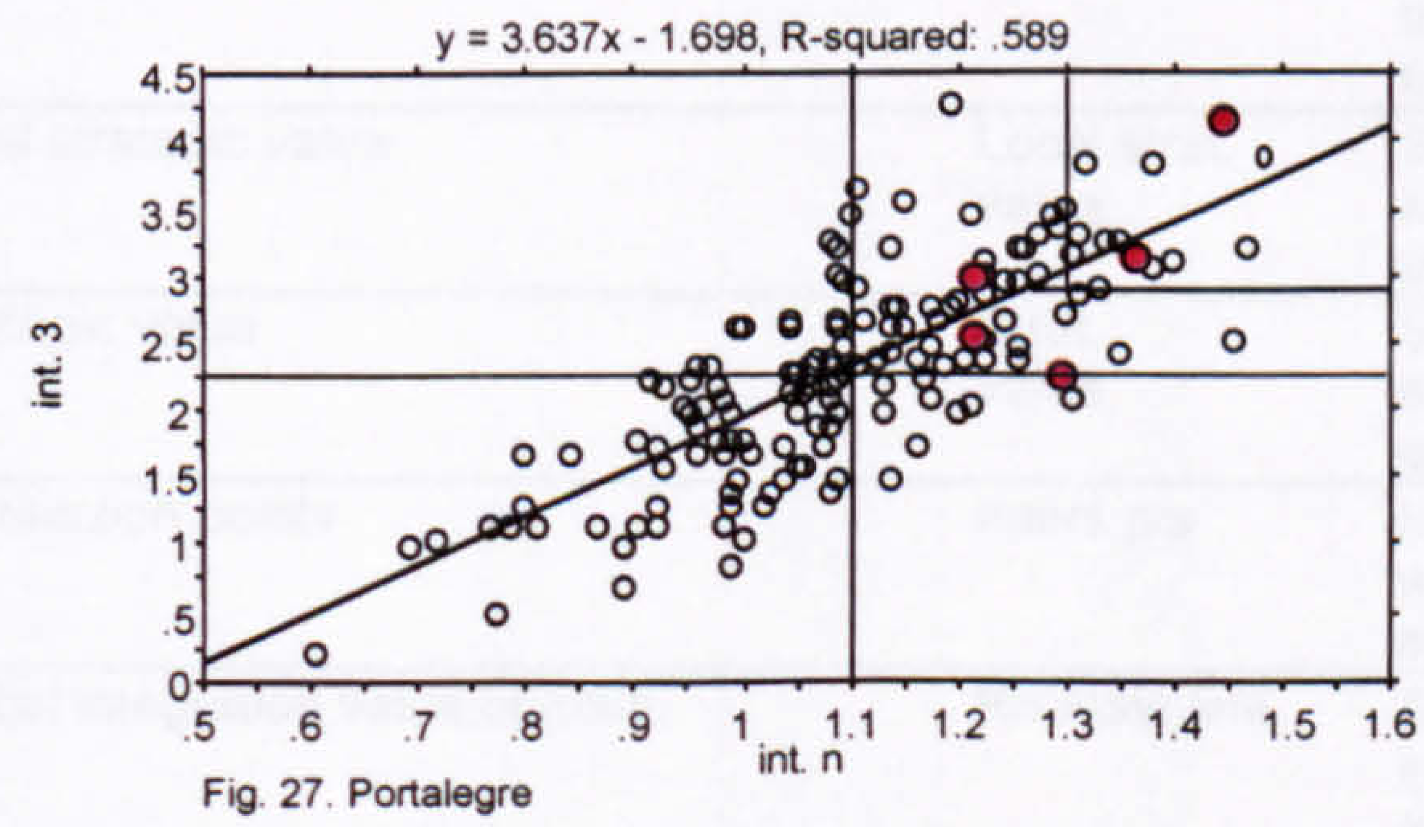


Fig. 27. Portalegre

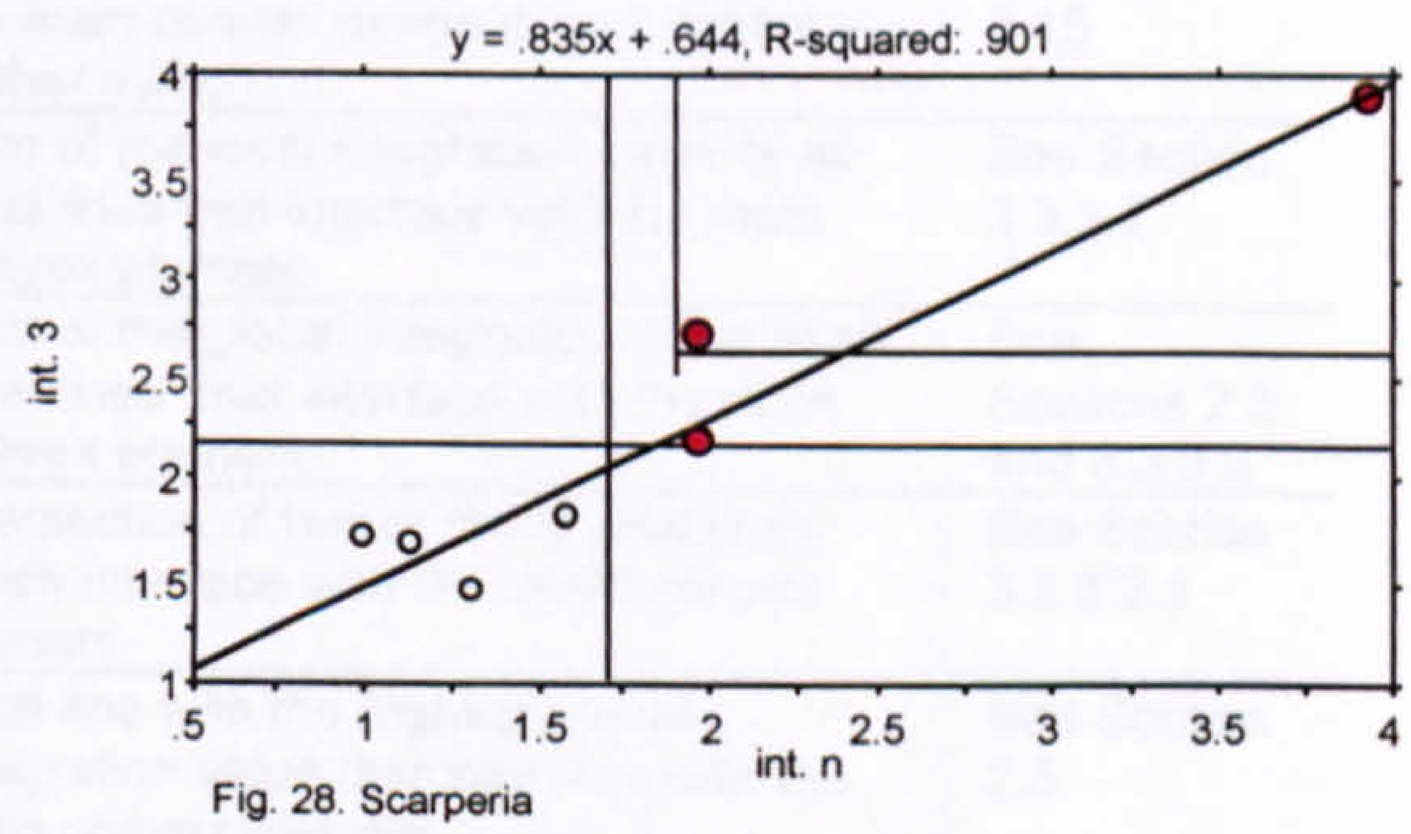


Fig. 28. Scarperia

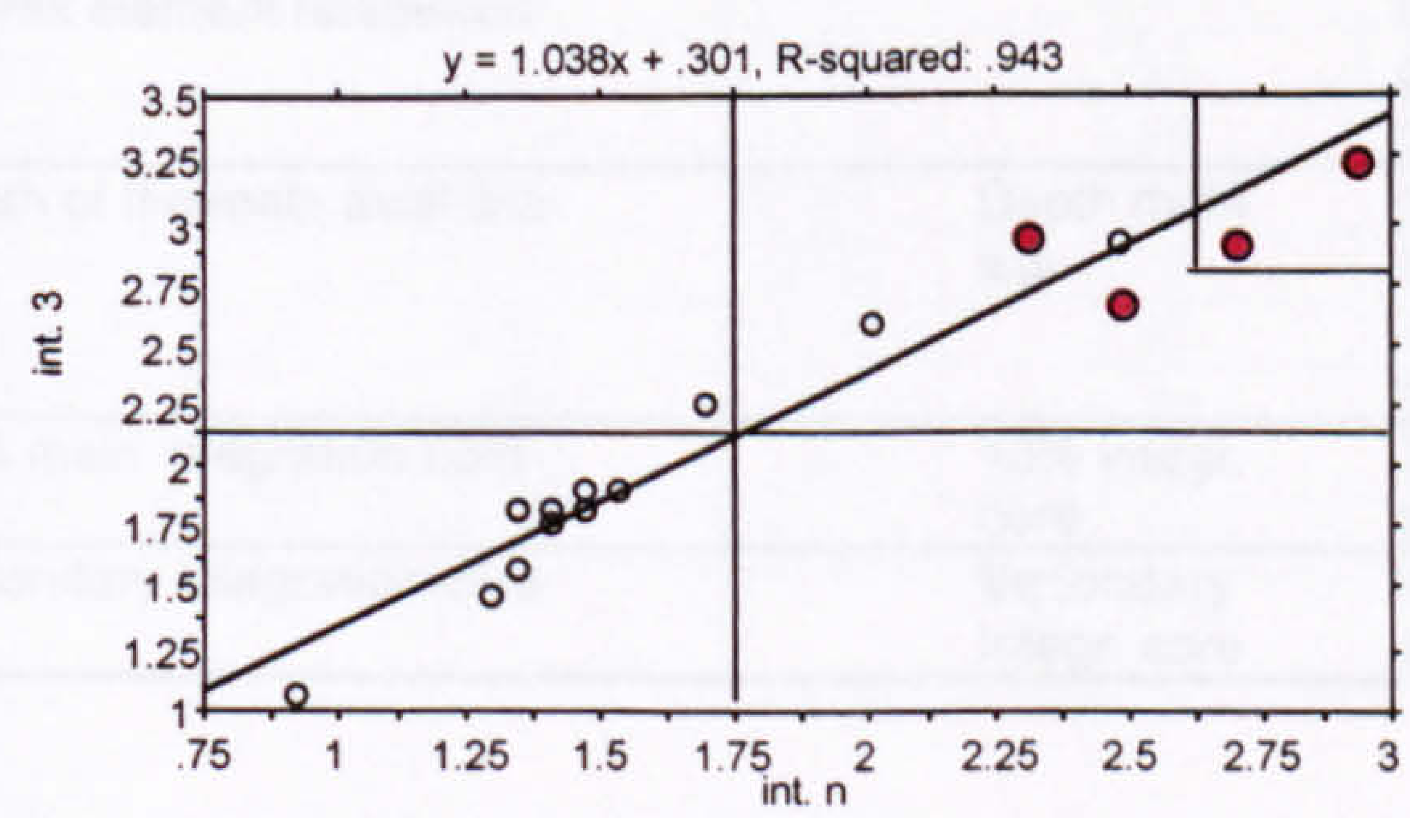


Fig. 29. Wielun

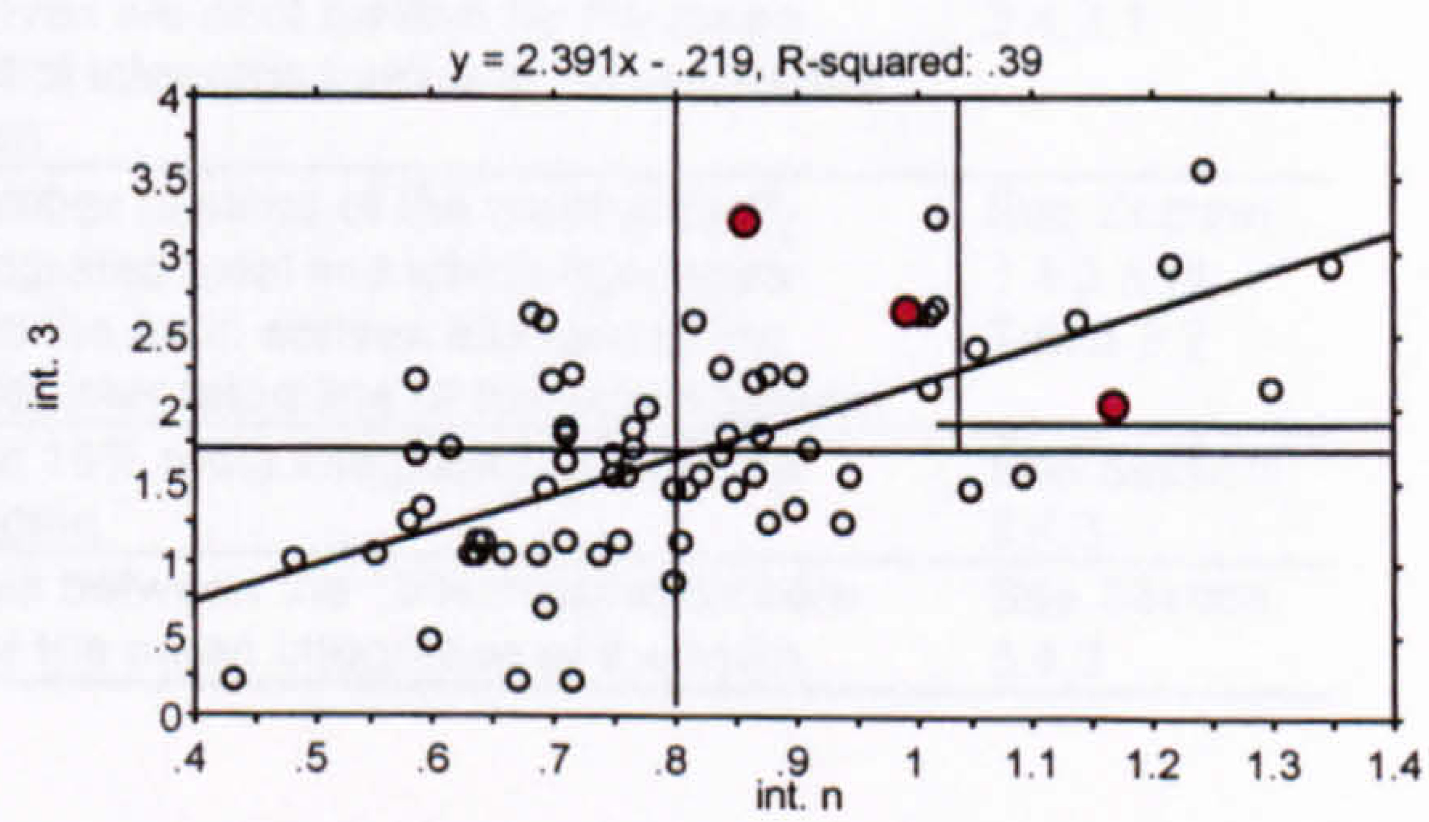


Fig. 30. Wolfsberg

Table 3.1. Urban squares in European towns: description of measurements

Measurement	Unit	Abbreviation	Description	Notes
Convex space		cvx. space	A polygon where no line drawn between any two points in space goes outside the space	See Section 2.4.1
Axial line		ax.line	Longest and straight line of accessibility and visibility	See Section 2.4.1
Convex isovist		Isovist or isov.	Set of all points visible from within the selected convex space	See Section 2.4.1
Main convex element		ce	Biggest convex space with regard to the area that could be inserted in the selected open space, limited by the façades of the buildings blocks	See Fig. 3.2
Main convex element area	m2	ce.A	Measurement of the surface of convex element	See Fig. 3.2
Convex isovist area	m2	Isov. A	Measurement of surface of convex isovist	See Fig. 3.10
Visibility ratio		V.R.	Isovist area divided by the main convex element area	See Section 3.3.3.1
Enclosure ratio		E.R	Unbuilt perimeter of the main convex element divided by built perimeter of the main convex element	See Fig. 3.12
Isovist length	m	Isov. length	longest straight line covering a branch of an isovist	See Fig. 3.11
Sum of the length of isovist	m	Sum isov. length	Sum of the longest straight line covering all different branches of a convex isovist	See Section 3.3.3.1
Mean of the sum of the length of the isovist	m	Mean sum isov. length	Sum of the longest straight line covering all different branches of a convex isovist divided by the number of lengths of the isovist	See Section 3.3.3.1
Sum of the length the axial lines	m	Sum axial lines length	Sum of the (metric) length of axial lines	See Section 3.3.3 2
Mean of the sum of the length of the axial lines	m	Mean sum ax.lines length	Sum of the (metric) length of axial lines divided by the number of axial lines	See Section 3.3.3.2
Global integration value		Rn	Relative depth of an axial line to all other lines of the system	See Section 2.4.2
Local integration value		R3	Relative depth of an axial line to all other lines of the system up to three steps away	See Section 2.4.2
Convergent axial line		C line	Axial line that crosses the main convex element but terminate within the main convex element	See Fig. 3.13
Transverse axial line		T line	Axial line that crosses the main convex element but continues further away	See Fig. 3.14
Peripheric axial line		P line	Axial line that crosses at the edges of the main convex element, and continue further away	See Fig. 3.15
Local strategic value		Local strat. value	Sum of the local integration value of all axial lines that interface with the main convex element	See Section 3.3.3.2
Strategic value		Strat. value	Sum of the global integration value of all axial lines that interface with the main convex element	See Sections 2.5 and 3.3.3 2
Intersection points		Inters.pts	Intersection of two or more axial lines which interface with the main convex element	See Section 3.3.3.2.1
Global integration value of main line		Rn main line	Axial line with the highest global integration value that interface with the main convex element	See Section 2.5
Global integration value of main convex element relativised		Rn value ceR	Global integration value of the main convex element divided by the mean global integration value of its respective town	See Section 3.4.3.1
Depth of the main axial line		Depth main line	Number of steps of the most globally integrated axial line which interfaces with the main convex element to the most integrated line of the urban system	See Section 3.4.3 and Table 3.2
10% main integration core		10% integr. core	The 10% most integrated lines of the system	See Section 3 4 3
Secondary integration core		Secondary integr. core	Area between the 10% integration core and the mean integration of the town	See Section 3 4 3

Table 3.2. Urban squares in European towns general data table (1/2)

Towns	Sample	Ref.	Country	Regularity	Function	Convexity	Location
Bruges	core and whole	1	Belgium	organic	main	singularity	center
Caernarvon	core and whole	2	UK	semi-regular	main	multiplicity	periphery
Esslingen	core and whole	3	Germany	organic	market	multiplicity	center
Evora	core and whole	4	Portugal	organic	main	multiplicity	off center
Heilbronn	core and whole	5	Germany	semi-regular	market	multiplicity	off center
Kempten	core and whole	6	Germany	organic	main	singularity	periphery
Kutna Hora	core and whole	7	Czech Republic	organic	main	multiplicity	center
Magdeburg	core and whole	8	Germany	organic	market	singularity	center
Moguer	core and whole	9	Spain	organic	main	multiplicity	off center
Nijmegen	core and whole	10	Netherlands	organic	main	multiplicity	off center
Palencia	core and whole	11	Spain	organic	main	singularity	off center
Pest	core and whole	12	Hungary	organic	main	singularity	periphery
S. Gimignano	core and whole	13	Italy	organic	main	multiplicity	off center
Salisbury	core and whole	14	UK	semi-regular	market	multiplicity	off center
Verdun	core and whole	15	France	organic	main	multiplicity	center
Volkermarkt	core and whole	16	Austria	semi-regular	market	multiplicity	periphery
Borgomanero	whole	17	Italy	geometric	main	multiplicity	center
Brive	whole	18	France	organic	church	multiplicity	center
Castellon	whole	19	Spain	semi-regular	civic	multiplicity	off center
Groningen	whole	20	Netherlands	semi-regular	main	multiplicity	off center
Gyor	whole	21	Hungary	geometric	market	singularity	off center
Kalisz	whole	22	Poland	geometric	market	singularity	center
Klatovy	whole	23	Czech Republic	geometric	civic	singularity	off center
Litomerice	whole	24	Czech Republic	semi-regular	main	singularity	off center
Modena	whole	25	Italy	organic	civic	multiplicity	off center
Montauban	whole	26	France	geometric	main	singularity	center
Portalegre	whole	27	Portugal	semi-regular	civic	multiplicity	periphery
Scarperia	whole	28	Italy	geometric	main	singularity	center
Wielun	whole	29	Poland	geometric	main	singularity	center
Wolfsberg	whole	30	Austria	semi-regular	church	multiplicity	off center

Towns	Main convex element area m2	Isovist area m2	Visibility ratio	Enclo-sure ratio	Sum isovist length	Mean sum isovist length	Sum axial lines length	Mean sum ax. lines length
Bruges	10442	21090	2.02	2.06	1532.9	153.29	2526	315.75
Caernarvon	659	4540	6.89	1.11	535.50	89.25	618	206.00
Esslingen	4792	9572	2	1.26	661.92	94.56	1004	200.80
Evora	6660	16800	2.52	1.43	1318.2	146.47	2396	266.22
Heilbronn	4292	12138	2.83	1.54	909.95	129.99	1428	285.60
Kempten	4588	11292	2.46	1.88	540.34	105.07	878	219.50
Kutna Hora	5168	9122	1.77	1.48	493.92	98.78	1656	331.20
Magdeburg	11230	36645	3.26	0.65	1537.20	128.10	2537	281.89
Moguer	1590	6310	3.97	1.39	628.58	125.72	1169	233.80
Nijmegen	2894	8490	2.93	1.45	572.46	114.49	824	206.00
Palencia	6324	4704	0.74	4.02	233.49	58.37	445	222.50
Pest	8900	24812	2.79	1.28	1086.62	155.23	2385	397.50
S. Gimignano	3563	6392	1.79	2.08	537.97	53.80	943	117.88
Salisbury	8900	16847	1.89	1.21	842.16	140.36	1334	333.50
Verdun	5187	31602	6.09	1.45	1443.93	180.49	2251	375.17
Volkermarkt	2848	10948	3.84	0.91	449.41	112.35	1073	214.60
Borgomanero	1680	13328	7.93	1.39	843.76	210.94	920	460.00
Brive	2340	6043	2.58	2.83	639.40	106.57	731	146.20
Castellon	3438	10128	2.95	0.39	686.98	98.14	1335	222.50
Groningen	27075	63512	2.35	1.99	1827.42	203.05	4490	561.25
Gyor	7518	22446	2.99	1.80	1618.30	161.83	2358	336.86
Kalisz	4340	11724	2.70	1.71	897.36	128.19	1224	306.00
Klatovy	9904	15774	1.59	3.11	1043.02	130.38	1577	315.40
Litomerice	17720	29878	1.69	3.12	1359.64	151.07	2613	326.62
Modena	5116	25420	4.97	0.34	1247.48	155.94	1177	294.25
Montauban	5316	16092	3.03	1.37	894.50	111.81	1514	216.29
Portalegre	4104	12176	2.97	1.55	819.99	136.67	1045	209.00
Scarperia	1140	5516	4.84	1.97	694.68	115.78	785	261.67
Wielun	3870	5418	1.40	2.30	453.43	113.36	1161	290.25
Wolfsberg	600.32	1376.3	2.29	1.93	123.40	30.85	311	103.67

Table 3.2. Urban squares in European towns general data table (2/2)

Towns	N° (C) ax. line	N° (T) ax. line	N° (P) ax. line	N° all ax. line	Sum R3 (C) ax lines	Sum R3 (T) axial lines	Sum R3 (P) axial lines	Sum R3 all axial lines	Sum Rn (C) axline	Sum Rn (T) ax. lines	Sum Rn (P) ax lines	Sum Rn all axial lines
Bruges	6	1	1	8	23.49	3.79	3.50	30.78	12.95	2.25	1.96	17.17
Caernarvon	1	•	2	3	2.02	•	6.40	8.42	1.48	•	4.57	6.05
Esslingen	3	1	1	5	8.60	2.66	3.69	14.95	4.10	1.26	1.49	6.85
Evora	9	•	•	9	33.62	•	•	33.62	16.68	•	•	16.68
Heilbronn	2	•	3	5	4.58	•	10.80	15.38	3.16	•	6.75	9.91
Kempten	2	1	1	4	4.51	2.24	3.03	9.78	2.63	1.39	1.54	5.57
Kutna Hora	5	•	•	5	18.86	•	•	18.86	9.63	•	•	9.63
Magdeburg	6	•	3	9	16.78	•	10.85	27.64	9.91	•	5.84	15.76
Moguer	5	•	•	5	16.47	•	•	16.47	8.32	•	•	8.32
Nijmegen	1	1	2	4	2.91	4 63	6.54	14.07	1 89	2.48	4.22	8.59
Palencia	•	•	2	2	•	•	4.22	4.22	•	•	2.64	2.64
Pest	4	•	2	6	12.49	•	7.61	20.10	7.84	•	4.32	12.16
S. Gimignano	7	•	1	8	18.98	•	4 04	23.03	12.83	•	2.73	15.56
Salisbury	2	•	2	4	4.96	•	6.91	11.87	3.57	•	6.50	10.07
Verdun	4	•	2	6	11.28	•	6.66	17.95	5.19	•	2.89	8.08
Volkermarkt	3	1	1	5	9.28	3.22	2.95	15.45	5.92	2.64	2.06	10.63
Borgomanero	•	2	•	2	•	6.82	•	6.82	•	5.55	•	5.55
Brive	4	1	•	5	10.81	3.51	•	14.32	7.01	1.89	•	8.90
Castellon	5	1	•	6	16.61	3.27	•	19.87	12.47	2.70	•	15.17
Groningen	5	2	1	8	19.51	10.11	4.35	33.96	12.92	6.57	2.66	22.14
Gyor	3	1	3	7	9.22	3.45	12.27	24.94	6.58	2.11	8.21	16.90
Kalisz	1	•	3	4	2.57	•	10.44	13.01	1.62	•	6.67	8.29
Klatovy	2	•	3	5	4.81	•	9.01	13.83	4.04	•	8.24	12.27
Litomerice	8	•	•	8	25.22	•	•	25.22	11.20	•	•	11.20
Modena	3	•	1	4	8.06	•	3.86	11.92	5.55	•	2.41	7.96
Montauban	6	•	1	7	17.75	•	3.21	20.95	11.91	•	2.25	14.16
Portalegre	4	1	•	5	12.14	3.00	•	15.15	5.30	1.22	•	6.52
Scarperia	•	•	3	3	•	•	8.88	8.88	•	•	7.83	7.83
Wielun	1	•	3	4	2.94	•	8.84	11.78	2.30	•	8.10	10.41
Wolfsberg	2	1	•	3	5.33	2.69	•	8.02	2.01	0.99	•	3.00

Towns	Rn main line	Total n° inters. points	2 axial lines per point	3 axial lines per point	Mean n° axial lines/ point	Total n° axial lines town	Dep th main line	% axial lines intgr. core	Rn value ce	Mean Rn value town	Rn value ce R
Bruges	2.43	12	9	3	2.25	166	1	100	2.1647	1.3409	1.6144
Caernarvon	2.68	2	2	0	2.00	29	1	66	1.6694	1.3222	1.2626
Esslingen	1.50	6	5	1	2.17	118	2	60	1.3318	1.0013	1.3301
Evora	2.13	11	8	3	2.27	294	1	100	1.8281	1.2574	1.4539
Heilbronn	2.57	6	6	0	2.00	74	2	40	1.8354	1.5922	1.1527
Kempten	1.54	2	1	1	2.50	47	5	0	1.1549	1.7097	0.6755
Kutna Hora	2.01	5	4	1	2.20	115	1	100	1.9140	1.2284	1.5581
Magdeburg	2.29	13	12	1	2.08	147	2	11	1.7208	1.5163	1.1349
Moguer	1.78	1	0	1	3.00	81	1	100	1.4986	1.2161	1.2323
Nijmegen	2.48	3	2	1	2.33	117	2	75	1.7993	1.4767	1.2185
Palencia	1.35	0	0	0	0	117	3	0	1.0624	1.1982	0.8866
Pest	2.81	7	5	2	2.29	65	1	33	1.8876	1.7005	1.1100
S. Gimignano	2.73	7	5	2	2.29	62	1	63	1.9960	1.4653	1.3622
Salisbury	3.45	2	1	1	2.50	24	1	50	2.0463	2.0905	0.9789
Verdun	1.72	5	3	2	2.40	60	1	17	1.1748	1.0241	1.1472
Volkermarkt	2.64	3	1	2	2.67	28	1	60	1.9364	1.5175	1.2760
Borgomanero	3.47	1	1	0	2.00	14	1	50	1.6813	1.7836	0.9426
Brive	2.33	1	1	0	2.00	95	1	60	1.8920	1.3461	1.4055
Castellon	3.00	6	5	1	2.17	323	3	0	2.1786	2.2635	0.9625
Groningen	3.50	14	10	4	2.29	98	1	88	2.5914	1.9014	1.3629
Gyor	3.05	10	9	1	2.10	47	1	57	2.4235	1.7850	1.3577
Kalisz	2.39	4	4	0	2.00	38	1	75	1.6535	1.5253	1.0840
Klatovy	2.94	5	4	1	2.20	15	2	50	2.0277	2.2889	0.8859
Litomerice	1.73	8	4	4	2.50	83	2	38	1.4515	1.1034	1.3155
Modena	2.41	4	4	0	2.00	158	2	25	1.8385	1.7183	1.0700
Montauban	2.25	5	2	3	2.60	32	2	0	2.0723	1.7612	1.1766
Portalegre	1.44	5	4	1	2.20	163	2	40	1.2233	1.1000	1.1121
Scarperia	3.92	2	2	0	2.00	12	1	67	1.8186	1.8557	0.9800
Wielun	2.93	4	4	0	2.00	18	1	50	2.2088	1.8725	1.1796
Wolfsberg	1.16	2	2	0	2.00	78	2	33	0.9823	0.824	1.1921

Table 3.3. Urban Squares in European towns correlation matrix – core sample

Variables	Main cnvex elem. area	Iso-vist area (m2)	Visibility ratio	Enclosure ratio	Sum isov. length	Mean sum isov. length	Sum axial lines length	Mean sum axline length	N° axial Line (C)	N° axial line (T)	N° axial line (P)
Main convex element area (m2)	1.00										
Isovist area (m2)	.949	1.00									
Visibility ratio	-.666	-.404	1.00								
Enclosure ratio	.743	.658	-.691	1.00							
Sum isovist length	.976	.939	-.591	.686	1.00						
Mean sum isovist length	.803	.906	-.179	.585	.879	1.00					
Sum axial lines length	.946	.979	-.413	.570	.969	.915	1.00				
Mean sum axial lines length	.941	.991	-.397	.689	.954	.947	.978	1.00			
N° axial lines (C)	.899	.926	-.394	.402	.878	.755	.946	.884	1.00		
N° axial lines (T)	•	•	•	•	•	•	•	•	•	•	
N° axial lines (P)	-.398	-.419	.204	-.075	-.226	-.037	-.342	-.297	-.598	•	1.00
Sum n° axial lines	.915	.940	-.393	.438	.938	.849	.983	.925	.976	•	-.408
Sum R3 value (C)	.913	.949	-.377	.436	.923	.837	.980	.926	.988	•	-.471
Sum R3 value (T)	.051	.114	.203	.003	.269	.499	.232	.228	-.018	•	.785
Sum R3 value (P)	-.287	-.361	.038	-.028	-.112	-.011	-.258	-.240	-.505	•	.978
Local strat. value	.879	.909	-.352	.437	.947	.905	.974	.922	.907	•	-.205
Sum Rn value (C)	.880	.951	-.275	.405	.898	.867	.976	.931	.976	•	-.454
Sum Rn value (T)	-.079	.166	.684	-.267	.098	.507	.225	.231	.084	•	.418
Sum Rn value (P)	-.347	-.308	.329	-.113	-.152	.109	-.225	-.184	-.486	•	.975
Strategic value	.762	.875	-.091	.330	.852	.943	.928	.895	.843	•	-.143
Rn value main line	.026	.263	.614	-.217	.203	.585	.329	.324	.191	•	.367
N° intersection pts	.933	.874	-.593	.501	.962	.776	.942	.871	.916	•	-.301

Variables	Sum n° axial lines	Sum R3 value (C)	Sum R3 value (T)	Sum R3 value (P)	Local strategic value	Sum Rn value (C)	Sum Rn value (T)	Sum Rn value (P)	Strategic value	Rn value main line	N° inter. points
Main convex element area (m2)											
Isovist area (m2)											
Visibility ratio											
Enclosure ratio											
Sum isovist length											
Mean sum isovist length											
Sum axial lines length											
Mean sum axial lines length											
N° axial lines (C)											
N° axial lines (T)											
N° axial lines (P)											
Sum n° axial lines	1.00										
Sum R3 value (C)	.997	1.00									
Sum R3 value (T)	.193	.129	1.00								
Sum R3 value (P)	-.309	-.379	.795	1.00							
Local strat. value	.977	.960	.395	-.106	1.00						
Sum Rn value (C)	.988	.993	.165	-.383	.956	1.00					
Sum Rn value (T)	.209	.188	.763	.329	.341	.282	1.00				
Sum Rn value (P)	-.288	-.348	.879	.937	-.077	-.312	.608	1.00			
Strategic value	.9211	.900	.484	-.097	.961	.938	.565	.028	1.00		
Rn value main line	.318	.296	.770	.295	.445	.384	.993	.564	.653	1.00	
N° intersection pts	.961	.943	.225	-.157	.954	.906	.057	-.229	.834	.170	1.00

Notes: 5 observations were used in this computation
11 cases were omitted due to missing values
A variable had a variance that was zero or missing

Table 3.4. Urban Squares in European towns correlation matrix – whole sample

Variables	Main cnvex elem. area	Iso-vist area (m2)	Visibi-lity ratio	Enclo sure ratio	Sum isov. length	Mean sum isov. length	Sum axial lines length	Mean sum axline length	N° axial Line (C)	N° axial line (T)	N° axial line (P)
Main convex element area (m2)	1.00										
Isovist area (m2)	.989	1.00									
Visibility ratio	-.365	-.242	1.00								
Enclosure ratio	.584	.537	-.619	1.00							
Sum isovist length	.788	.787	-.359	.728	1.00						
Mean sum isovist length	.887	.911	-.154	.644	.935	1.00					
Sum axial lines length	.960	.962	-.287	.618	.914	.970	1.00				
Mean sum axial lines length	.974	.988	-.242	.604	.867	.960	.987	1.00			
N° axial lines (C)	.660	.600	-.430	.490	.736	.656	.742	.638	1.00		
N° axial lines (T)	.949	.958	-.207	.381	.587	.769	.851	.905	.444	1.00	
N° axial lines (P)	-.194	-.106	.306	.092	.255	.181	-.015	-.001	-.355	-.240	1.00
Sum n° axial lines	.751	.734	-.322	.593	.946	.875	.888	.806	.898	.533	.051
Sum R3 value (C)	.697	.638	-.421	.518	.759	.704	.776	.676	.989	.489	-.330
Sum R3 value (T)	.916	.928	-.138	.370	.620	.812	.849	.893	.420	.958	-.109
Sum R3 value (P)	- 039	.046	.215	.182	.410	.319	.145	.153	-.217	-.111	.980
Local strat. value	.820	.805	-.307	.596	.947	.924	.931	.865	.854	.635	.052
Sum Rn value (C)	.786	.752	-.318	.538	.831	.821	.871	.791	.962	.600	-.236
Sum Rn value (T)	.904	.931	-.004	.301	.591	.814	.849	.893	.446	.957	-.155
Sum Rn value (P)	-.030	.066	.318	.158	.407	.351	.163	.173	-.207	-.092	.980
Strategic value	.824	.844	-.110	.542	.936	.972	.945	.903	.753	.679	.161
Rn value main line	.654	.731	.323	.241	.701	.860	.767	.774	.386	.632	.356
N° intersection pts	.821	.797	-.449	.637	.966	.891	.922	.856	.842	.624	.069

Variables	Sum n° axial lines	Sum R3 value (C)	Sum R3 value (T)	Sum R3 value (P)	Local strate gic value	Sum Rn value (C)	Sum Rn value (T)	Sum Rn value (P)	Strate gic value	Rn value main line	N° inter. points
Main convex element area (m2)											
Isovist area (m2)											
Visibility ratio											
Enclosure ratio											
Sum isovist length											
Mean sum isovist length											
Sum axial lines length											
Mean sum axial lines length											
N° axial lines (C)											
N° axial lines (T)											
N° axial lines (P)											
Sum n° axial lines	1.00										
Sum R3 value (C)	.908	1.00									
Sum R3 value (T)	.560	.500	1.00								
Sum R3 value (P)	.207	-.198	-.005	1.00							
Local strat. value	.979	.891	.695	.197	1.00						
Sum Rn value (C)	.948	.980	.614	-.095	.944	1.00					
Sum Rn value (T)	.564	.514	.980	-.051	.684	.641	1.00				
Sum Rn value (P)	.216	-.185	.027	.991	.213	-.069	-.001	1.00			
Strategic value	.940	.793	.742	.299	.971	.890	.757	.337	1.00		
Rn value main line	.664	.455	.750	.434	.744	.608	.792	.510	.870	1.00	
N° intersection pts	.973	.862	649	.234	.976	.903	.617	.222	.924	.641	1.00

Notes: 7 observations were used in this computation
23 cases were omitted due to missing values

APPENDIX 2

THE MORPHOLOGY OF PUBLIC SPACES IN THE CITY OF LONDON

Plate 4.1 - Abchurchyard - plans and views

Figure A: location plan

Legend:

Public spaces

1. Abchurchyard
2. Bank Corner
3. Exchange Square
4. Fenchurch Place
5. Finsbury Av.
6. Fleet Place
7. Love Lane Corner
8. New Change/Cheapside
9. North Guildhall
10. Royal Exchange
11. St Anne & St Agnes
12. Whittington Gardens

Reference points

a. St. Paul's Cathedral
b. Barbican Centre
c. Bank of England
d. Finsbury Circus
e. Liverpool Station
f. Leadenhall Market
g. Tower of London
h. Lloyd's Building

public space
wine bar or pub
commercial outlets
access
designated seats

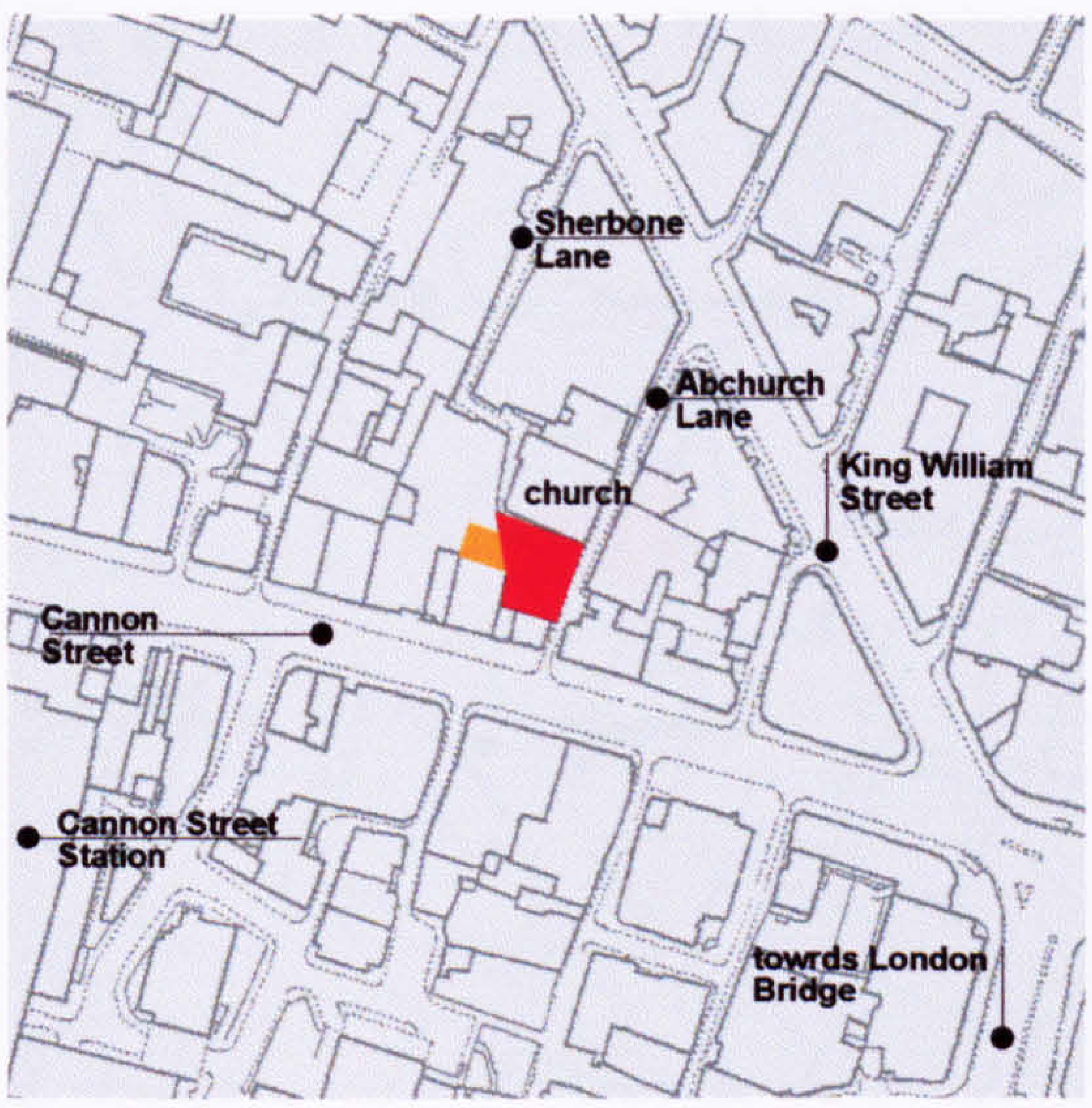


Figure B: site plan
scale: 1:3500

Figure C: public space plan
scale:1:750

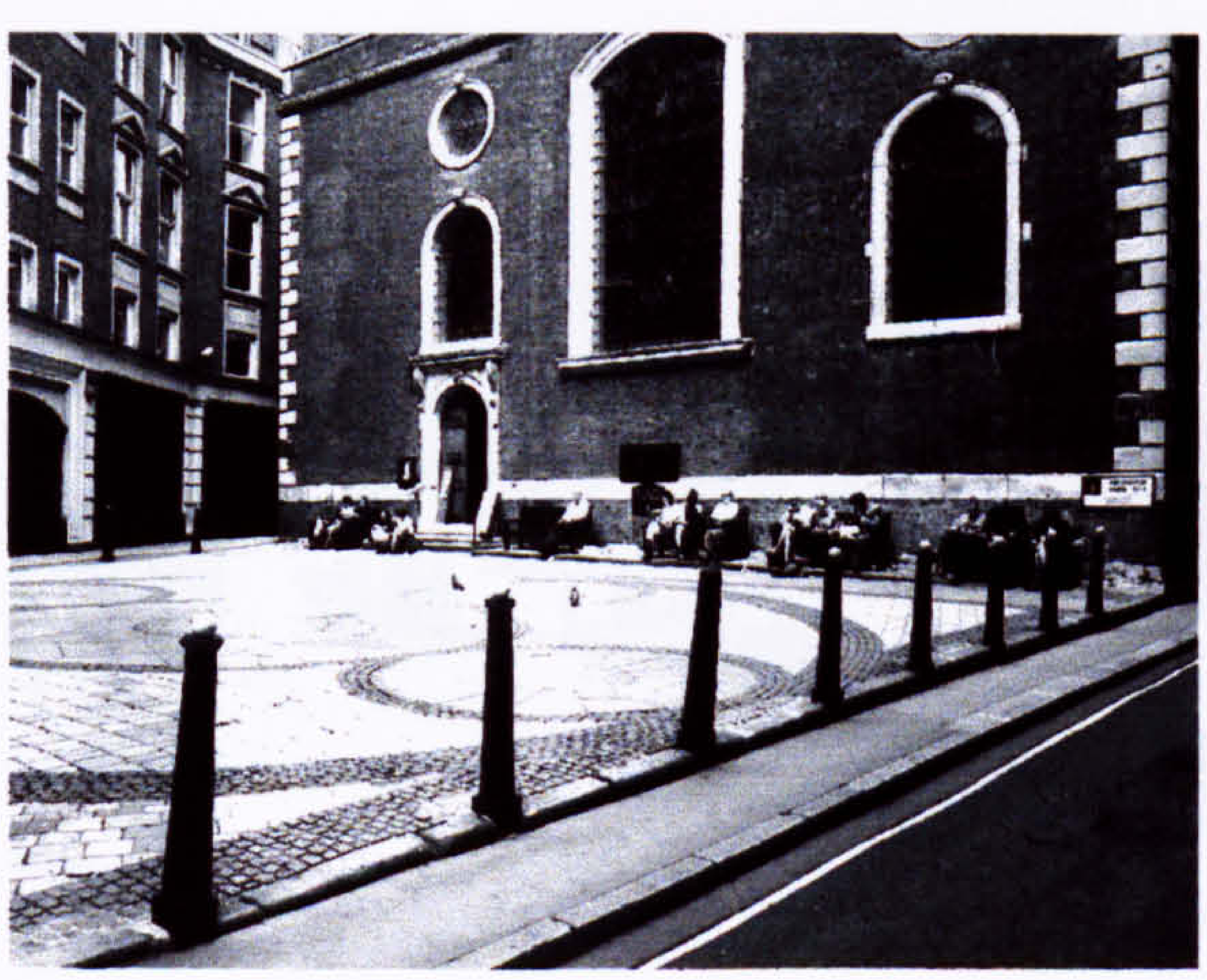


Figure D

Figure E

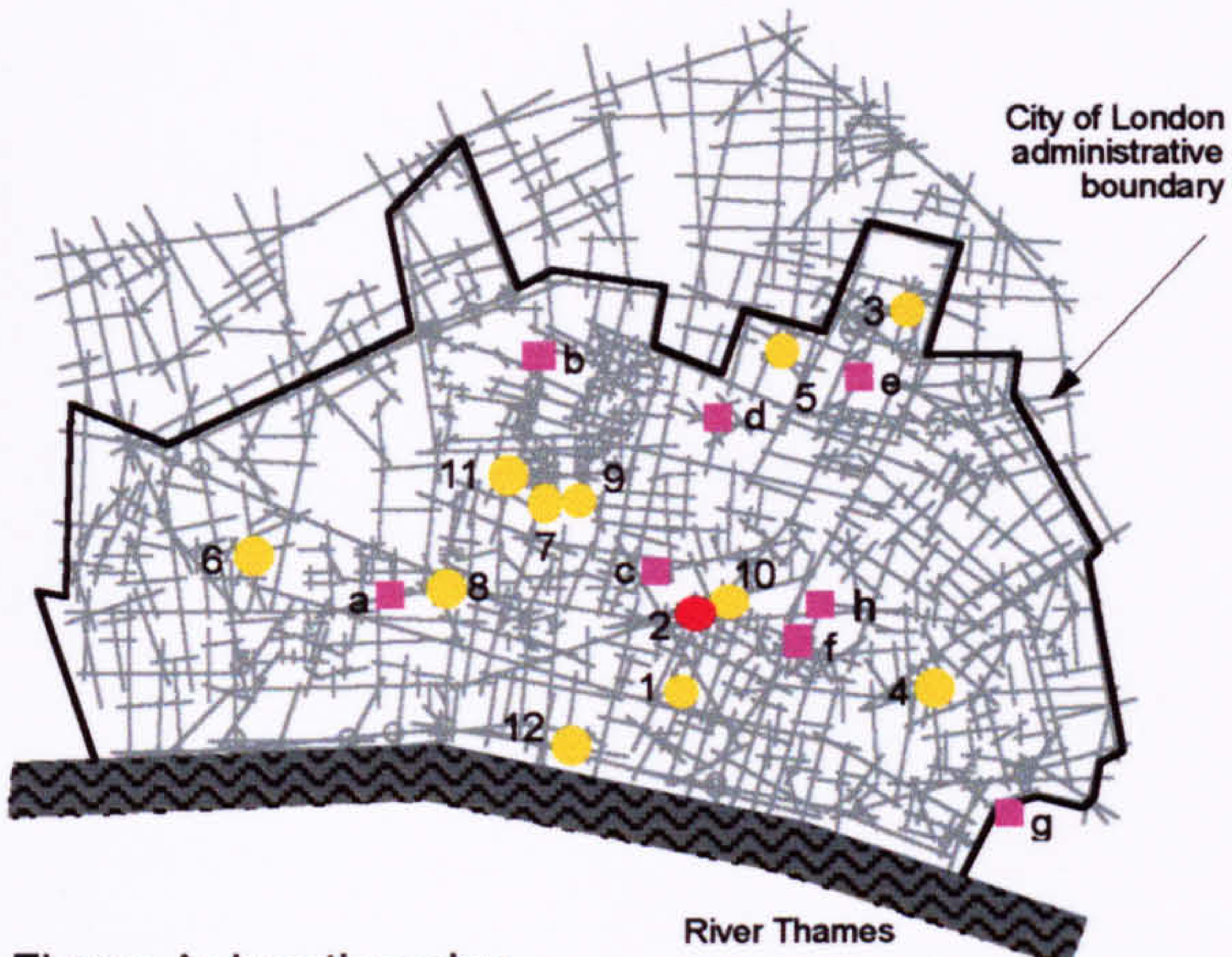


Figure A: location plan

Legend:

Public spaces

1. Abchurchyard
2. Bank Corner
3. Exchange Square
4. Fenchurch Place
5. Finsbury Av.
6. Fleet Place
7. Love Lane Corner
8. New Change/Cheapside
9. North Guildhall
10. Royal Exchange
11. St Anne & St Agnes
12. Whittington Gardens

Reference points

a. St. Paul's Cathedral
b. Barbican Centre
c. Bank of England
d. Finsbury Circus
e. Liverpool Station
f. Leadenhall Market
g. Tower of London
h. Lloyd's Building

public space
wine bar or pub
commercial outlets
access
designated seats

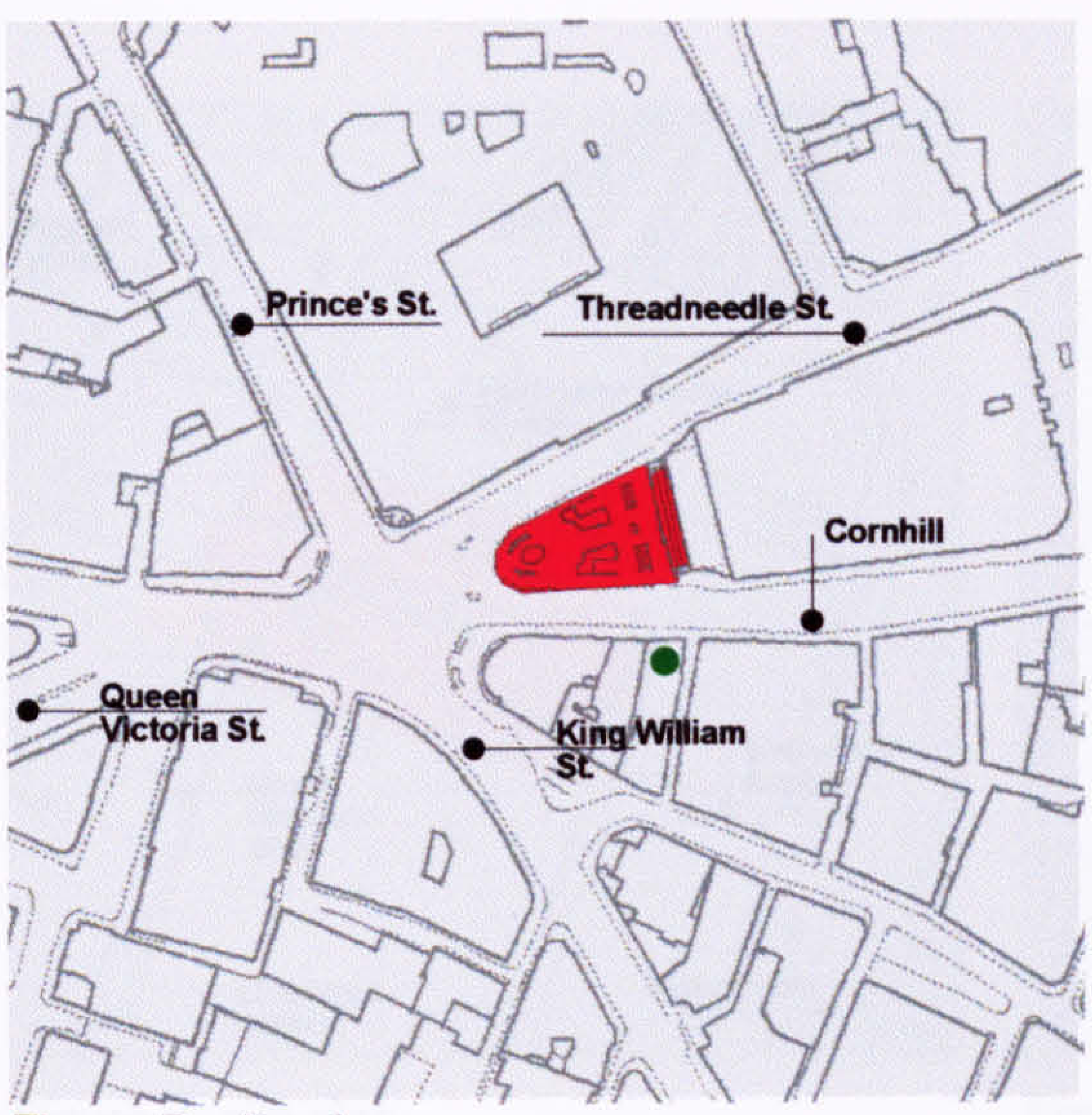


Figure B: site plan
scale: 1:3500

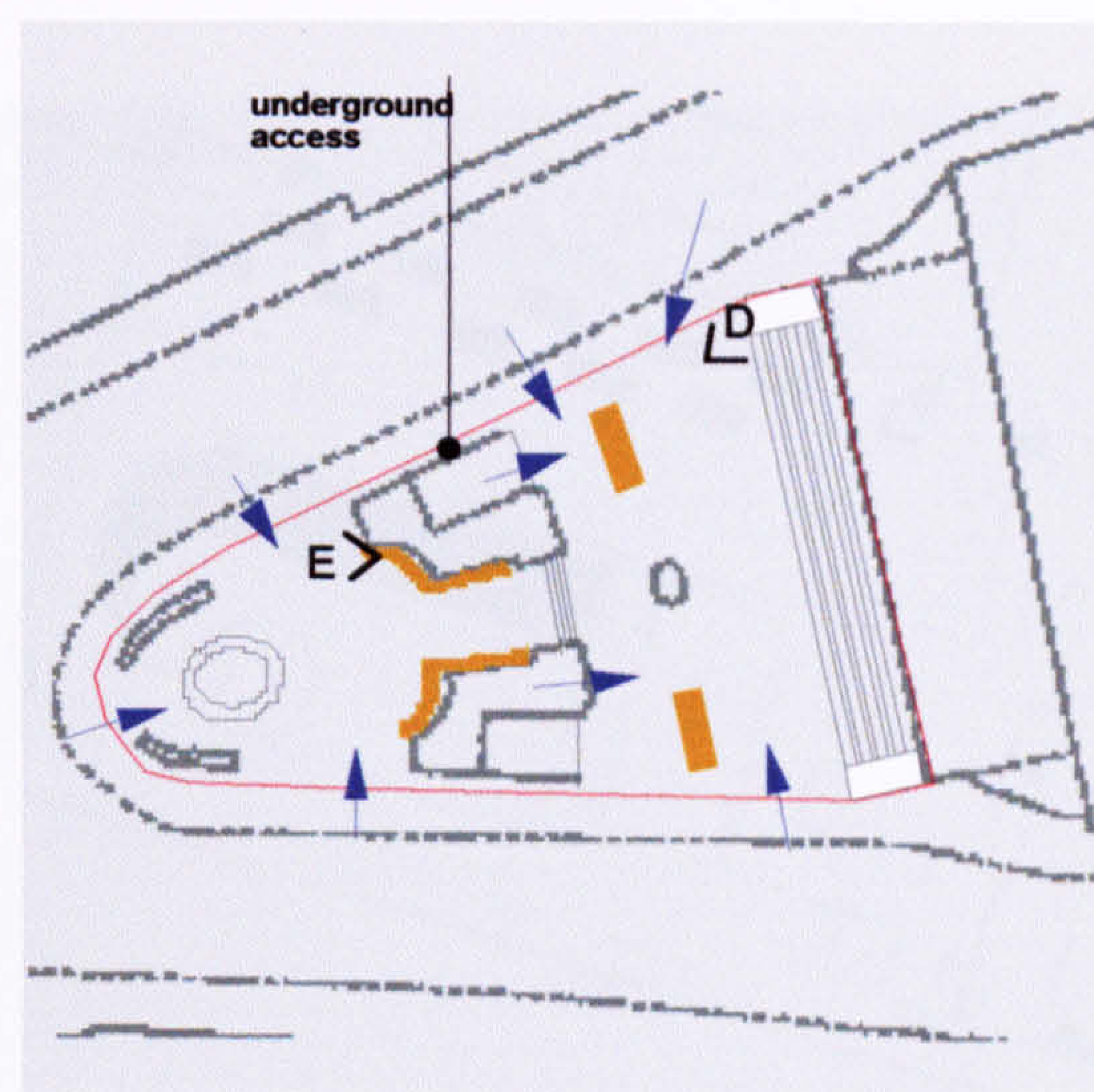


Figure C: public space plan
scale:1:850

Figure D

Figure E

Plate 4.3 - Exchange Square - plans and views

Figure A: location plan

Legend:

Public spaces

1. Abchurchyard
2. Bank Corner
3. Exchange Square
4. Fenchurch Place
5. Finsbury Av.
6. Fleet Place
7. Love Lane Corner
8. New Change/Cheapside
9. North Guildhall
10. Royal Exchange
11. St Anne & St Agnes
12. Whittington Gardens

Reference points

a. St. Paul's Cathedral
b. Barbican Centre
c. Bank of England
d. Finsbury Circus
e. Liverpool Station
f. Leadenhall Market
g. Tower of London
h. Lloyd's Building

public space
wine bar or pub
commercial outlets
access
designated seats

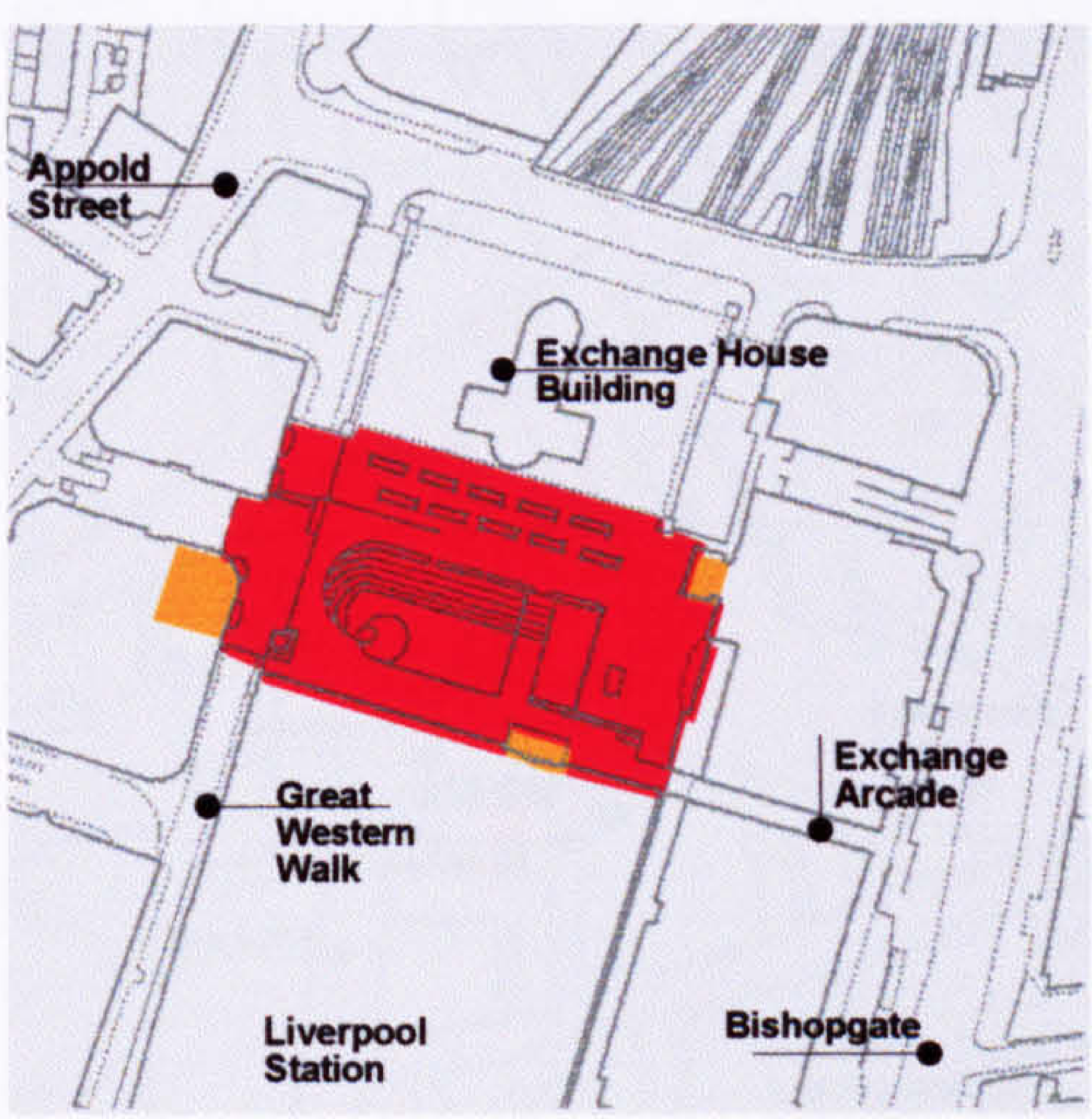


Figure B: site plan
scale: 1:4000

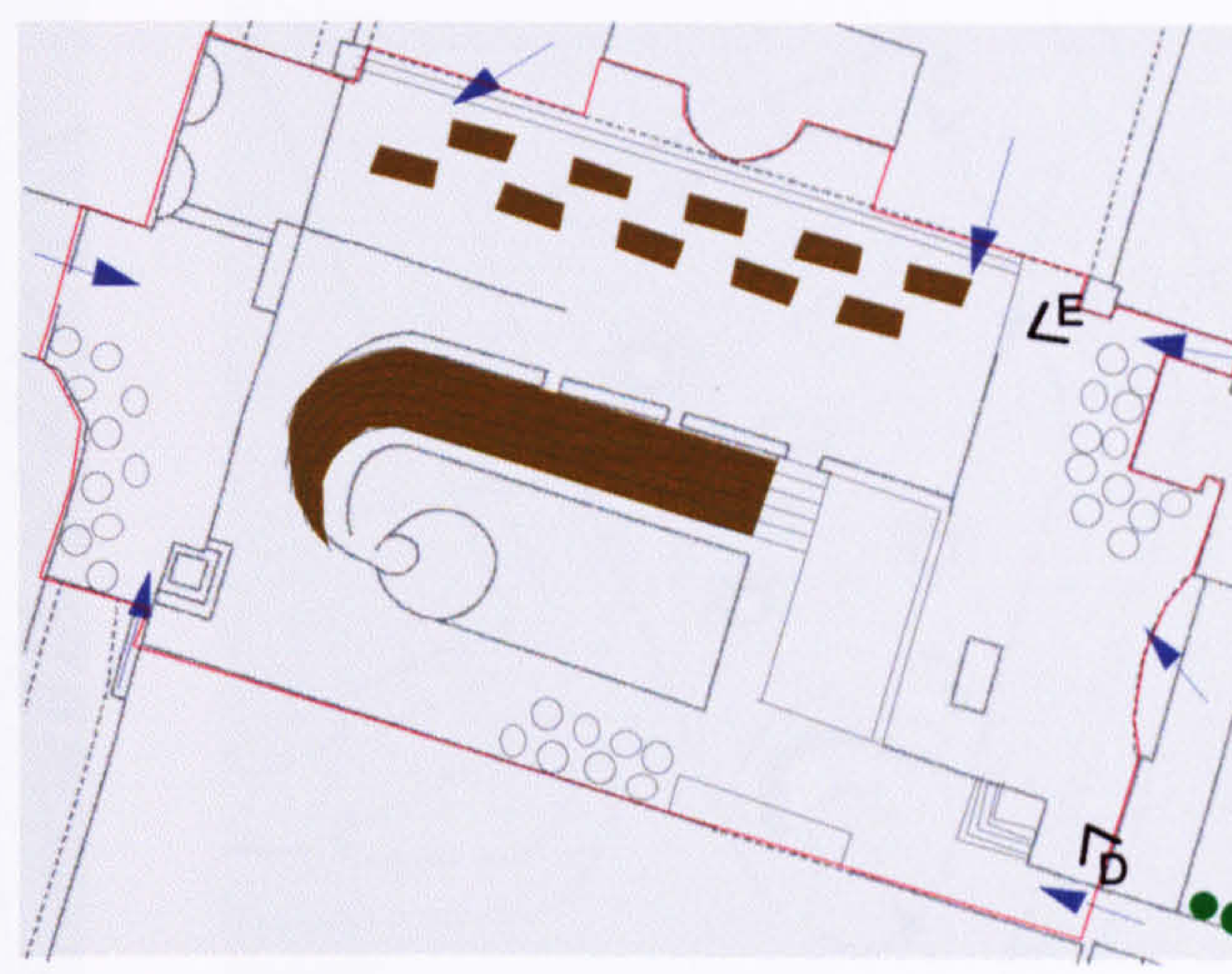


Figure C: public space plan
scale:1:1400

Figure D

Figure E

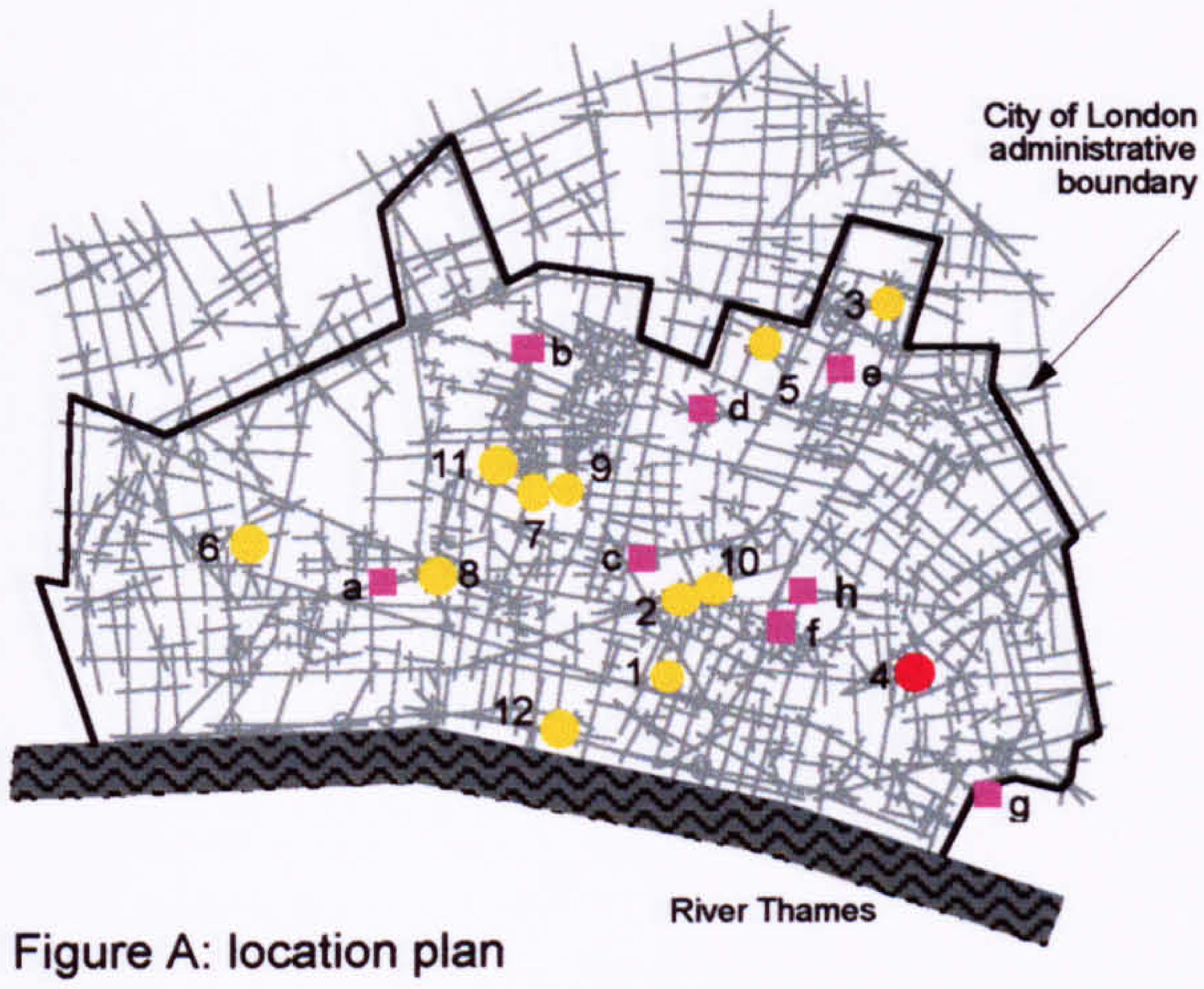


Figure A: location plan

Legend:

Public spaces

1. Abchurchyard
2. Bank Corner
3. Exchange Square
4. Fenchurch Place
5. Finsbury Av.
6. Fleet Place
7. Love Lane Corner
8. New Change/Cheapside
9. North Guildhall
10. Royal Exchange
11. St Anne & St Agnes
12. Whittington Gardens

Reference points

a. St. Paul's Cathedral
b. Barbican Centre
c. Bank of England
d. Finsbury Circus
e. Liverpool Station
f. Leadenhall Market
g. Tower of London
h. Lloyd's Building

public space
wine bar or pub
commercial outlets
access
designated seats

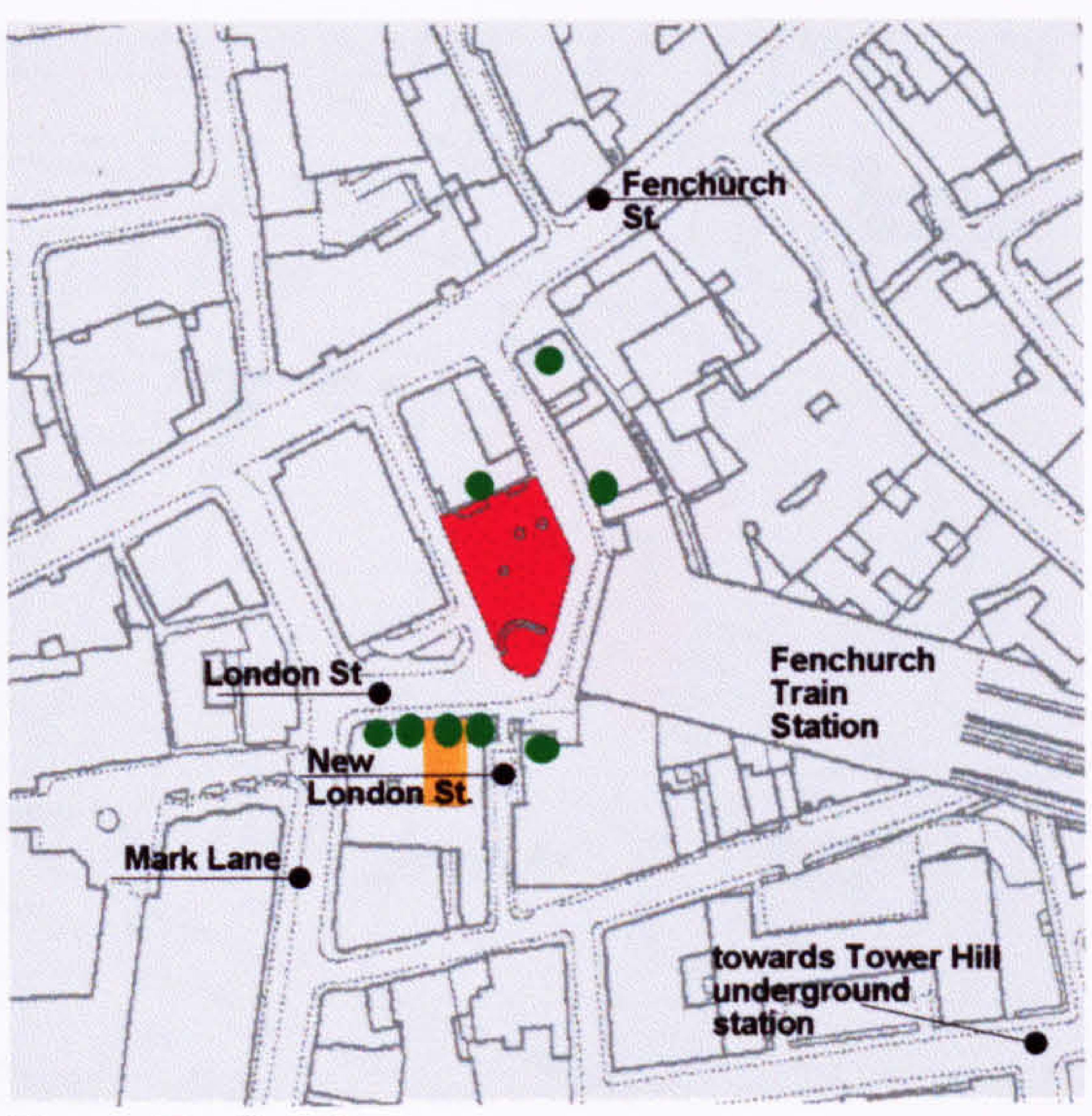


Figure B: site plan
scale: 1:3500

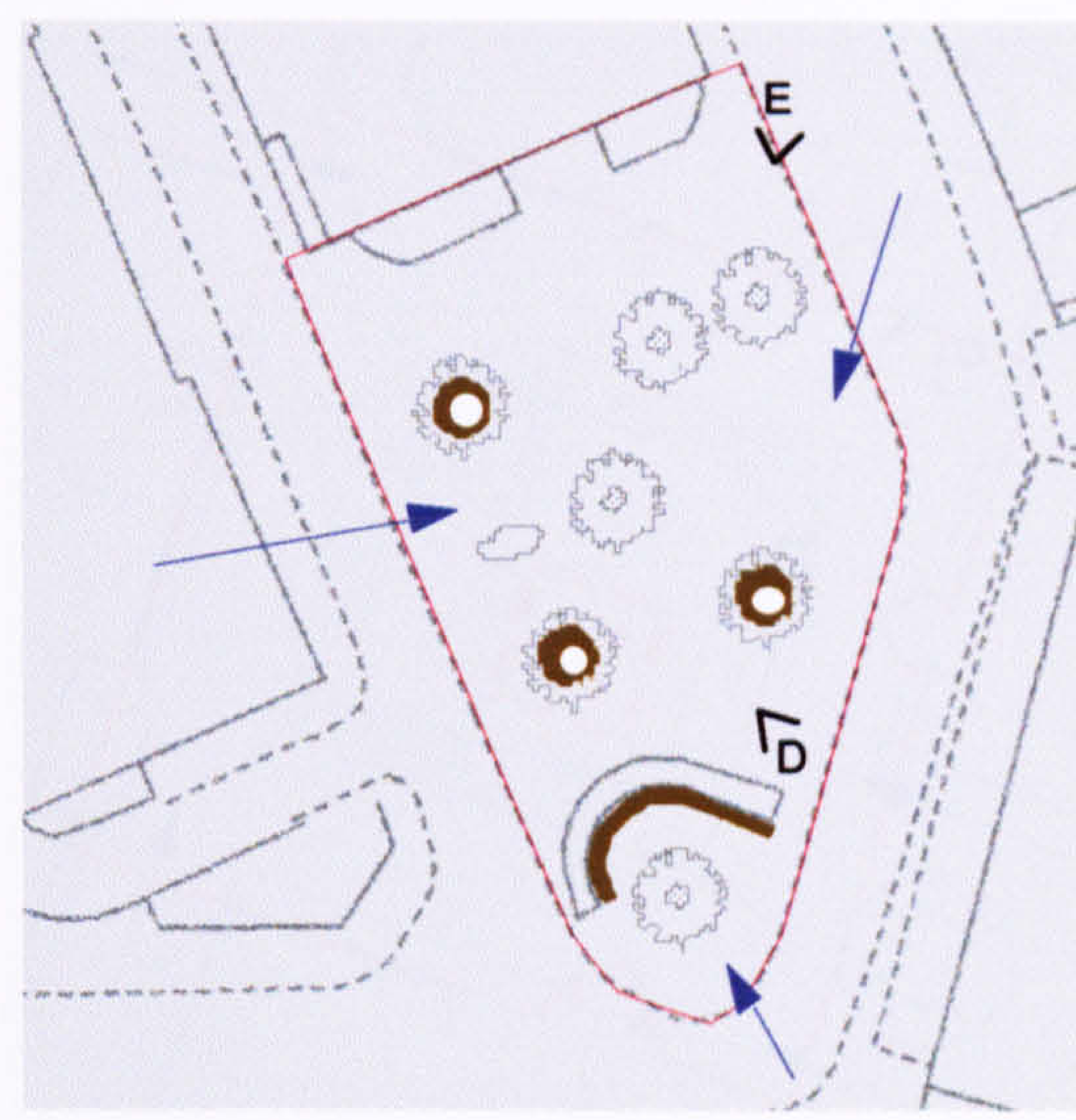


Figure C: public space plan
scale:1:750

Figure D

Figure E

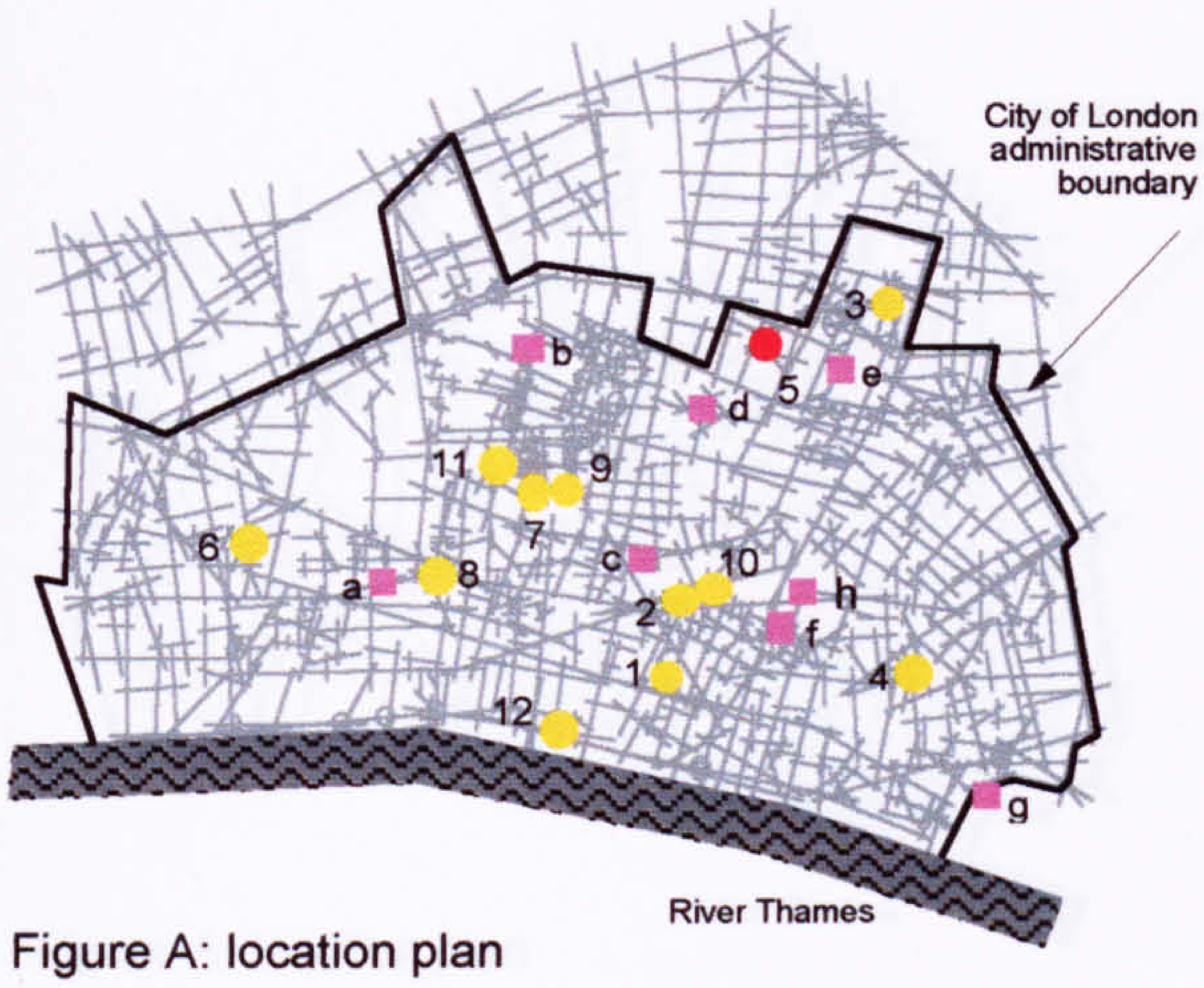


Figure A: location plan

Legend:

Public spaces

1. Abchurchyard
2. Bank Corner
3. Exchange Square
4. Fenchurch Place
5. Finsbury Av.
6. Fleet Place
7. Love Lane Corner
8. New Change/Cheapside
9. North Guildhall
10. Royal Exchange
11. St Anne & St Agnes
12. Whittington Gardens

Reference points

a. St. Paul's Cathedral
b. Barbican Centre
c. Bank of England
d. Finsbury Circus
e. Liverpool Station
f. Leadenhall Market
g. Tower of London
h. Lloyd's Building

public space
wine bar or pub
commercial outlets
access
designated seats

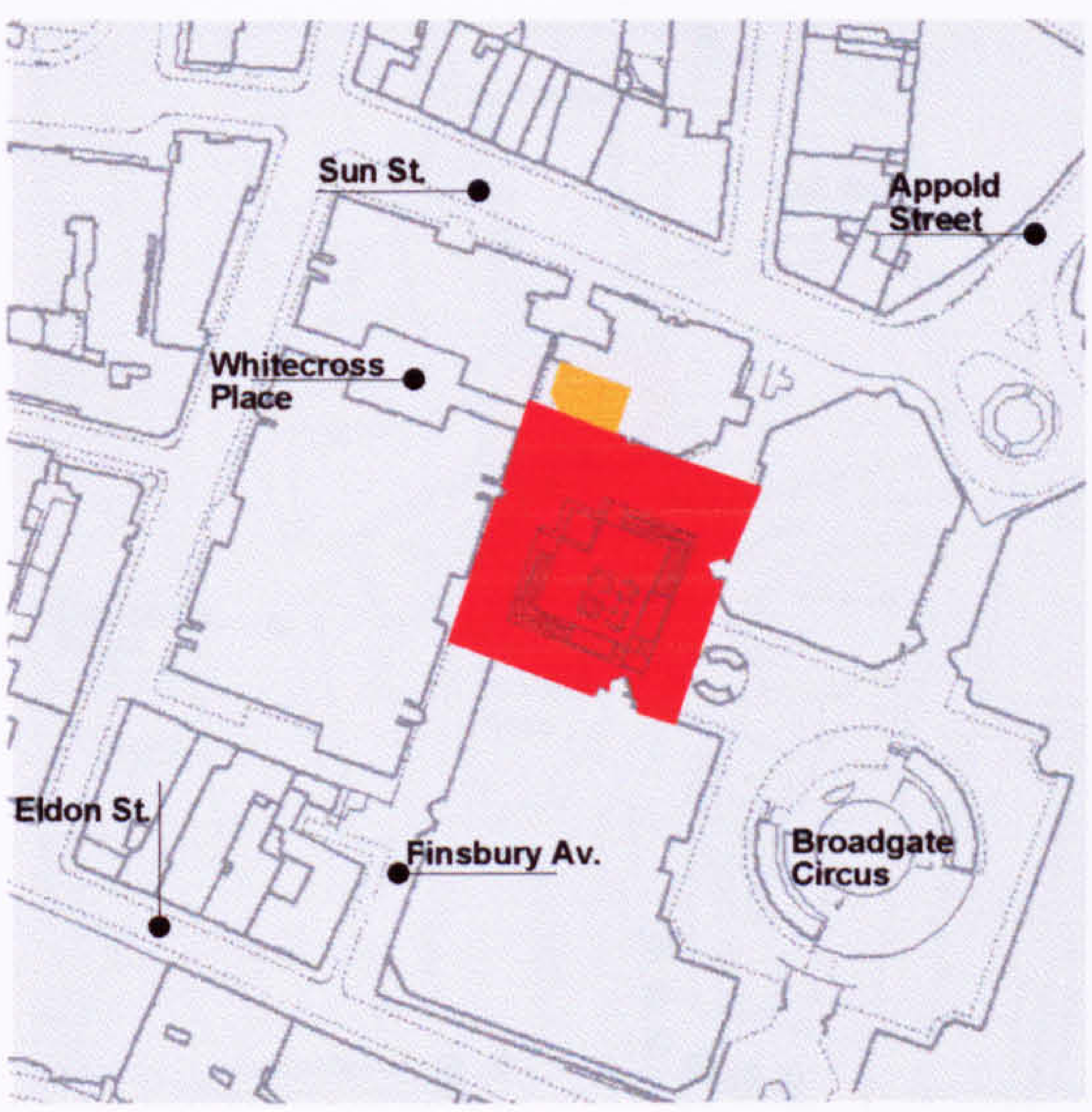


Figure B: site plan
scale: 1:3500

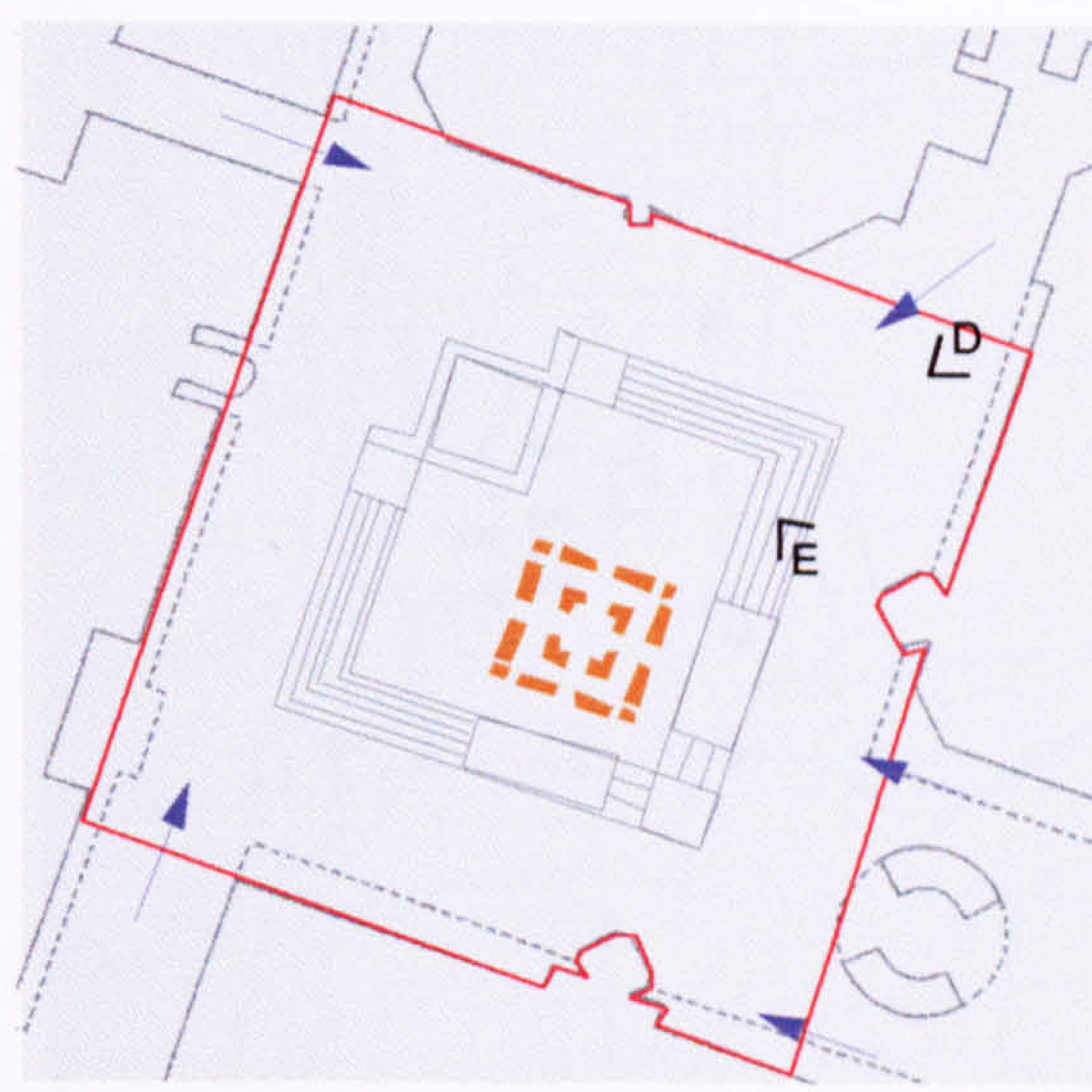
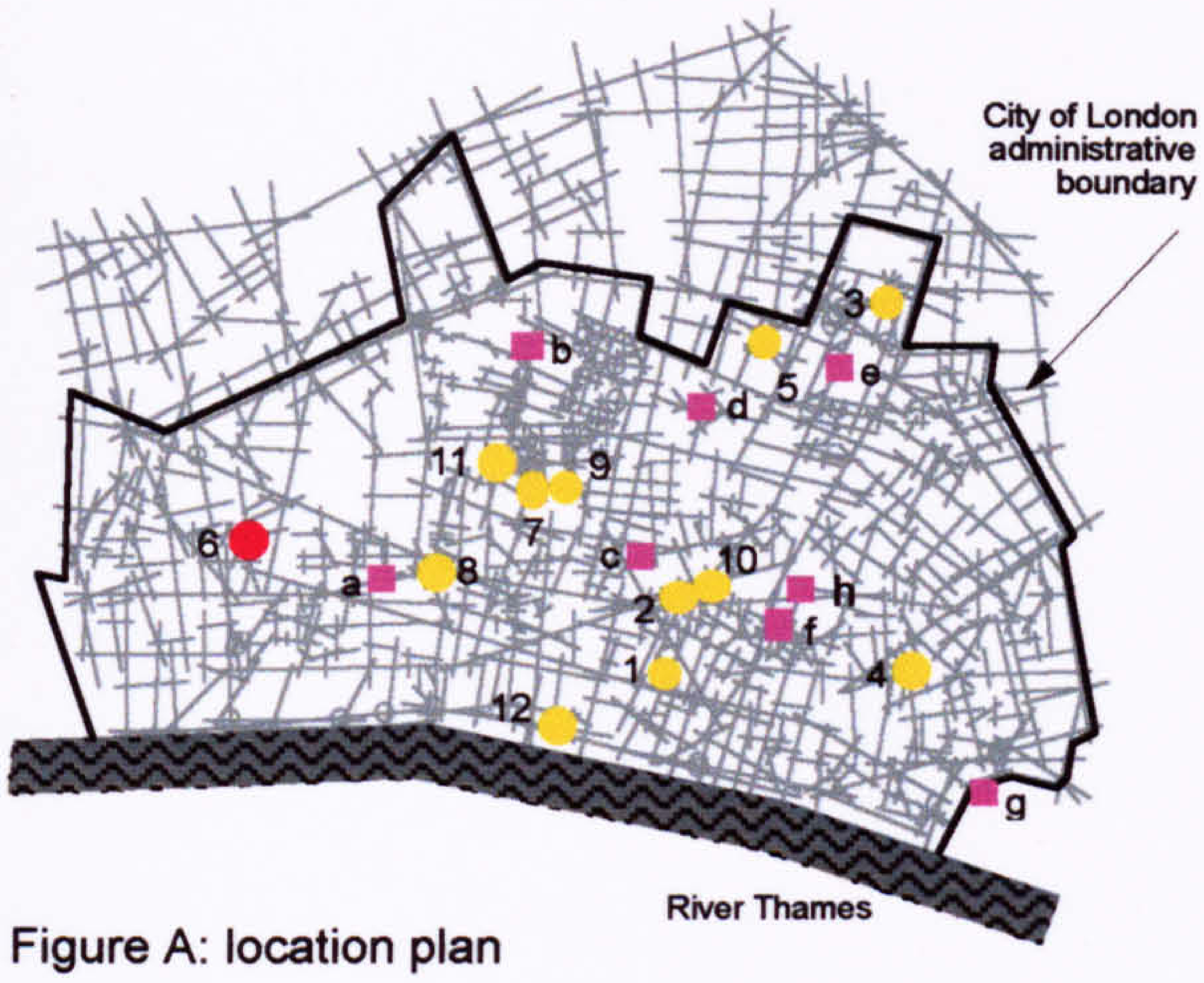


Figure C: public space plan
scale:1:1150

Figure D

Figure E

Plate 4.6 - Fleet Place - plans and views



Legend:

Public spaces

1. Abchurchyard
2. Bank Corner
3. Exchange Square
4. Fenchurch Place
5. Finsbury Av.
6. Fleet Place
7. Love Lane Corner
8. New Change/Cheapside
9. North Guildhall
10. Royal Exchange
11. St Anne & St Agnes
12. Whittington Gardens

Reference points

a. St. Paul's Cathedral
b. Barbican Centre
c. Bank of England
d. Finsbury Circus
e. Liverpool Station
f. Leadenhall Market
g. Tower of London
h. Lloyd's Building

public space
wine bar or pub
commercial outlets
access
designated seats

Figure A: location plan

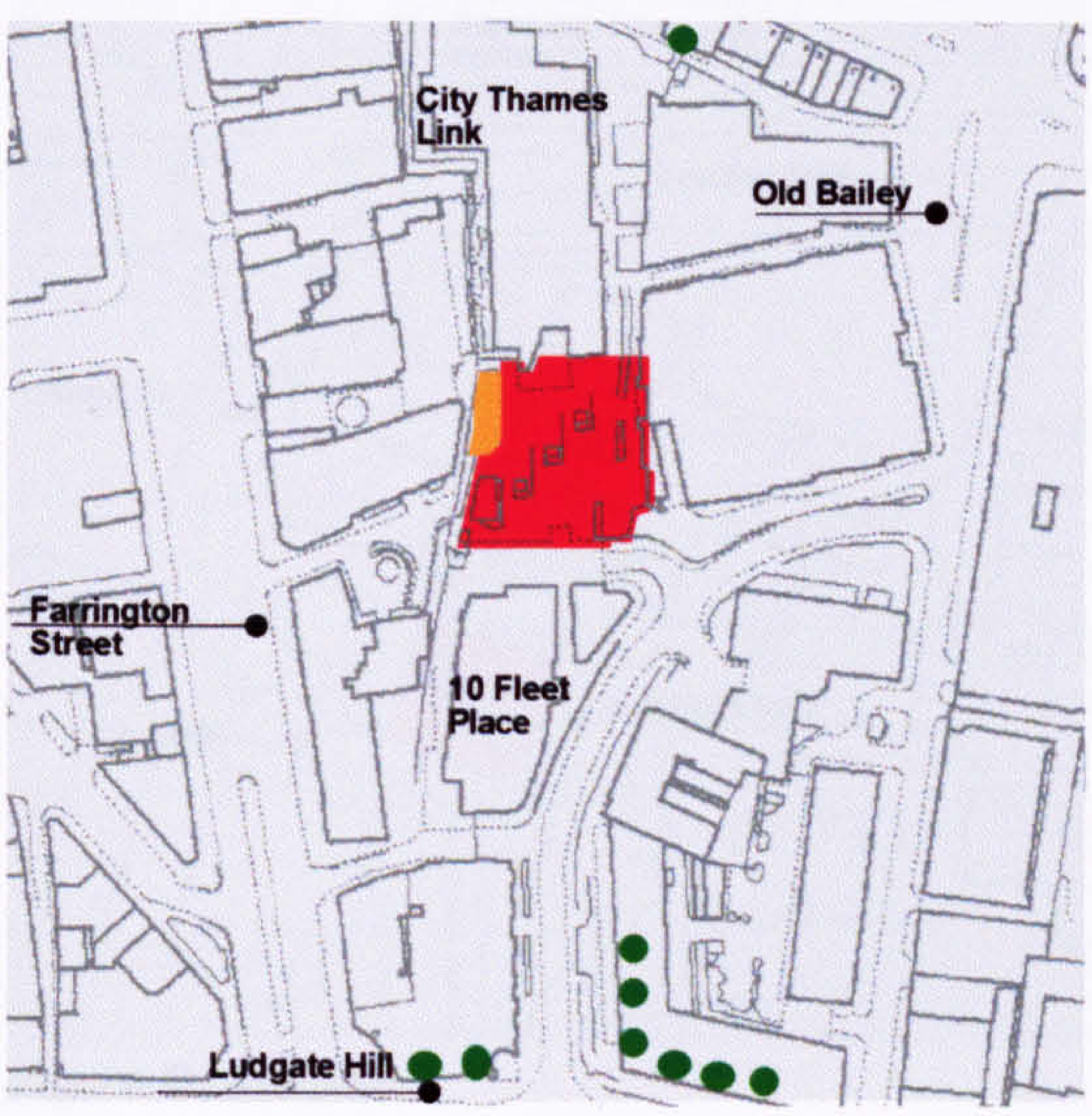


Figure B: site plan
scale: 1:3500

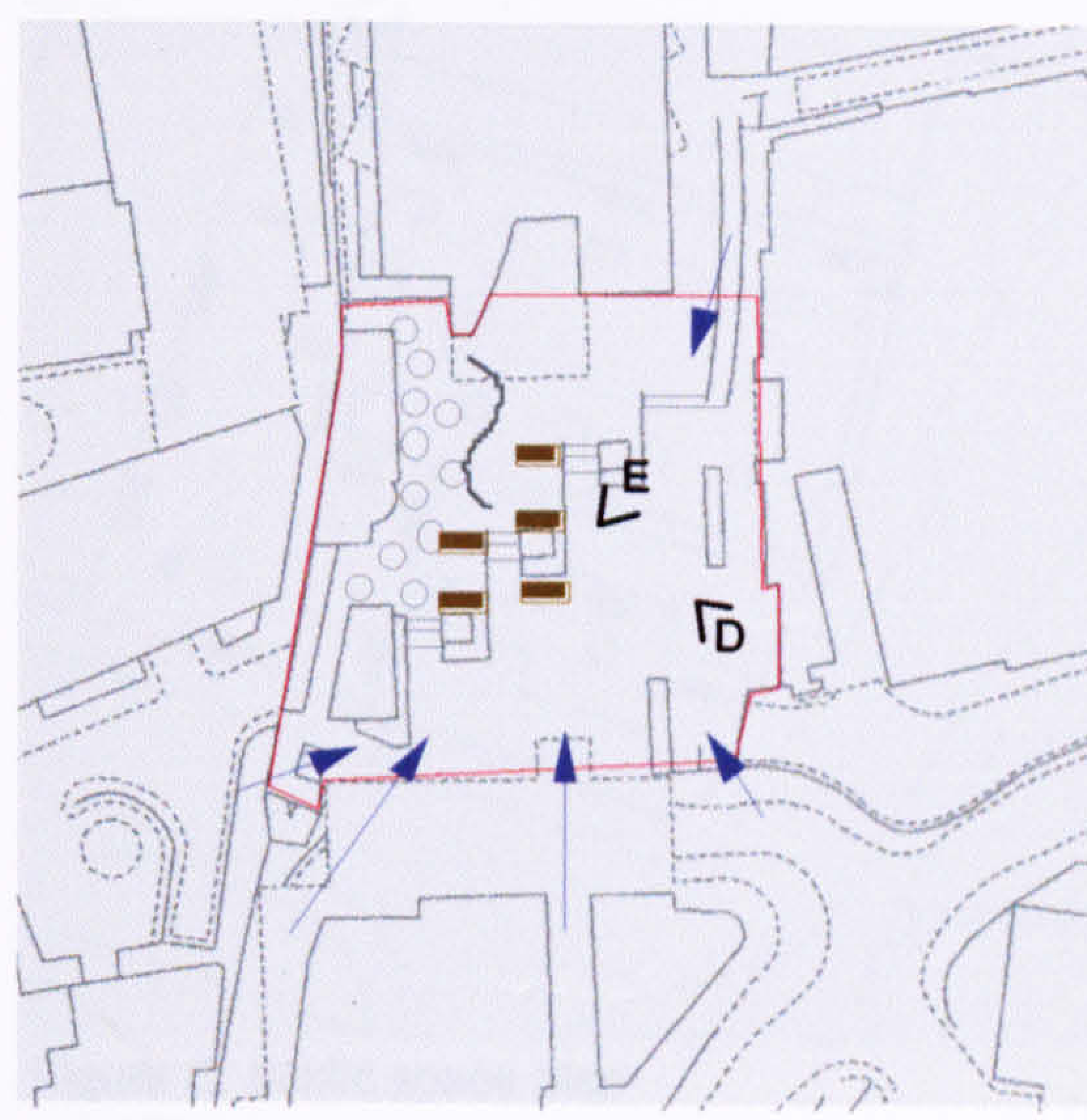


Figure C: public space plan
scale:1:1400

Figure D

Figure E

Plate 4.7 - Love Lane Corner - plans and views

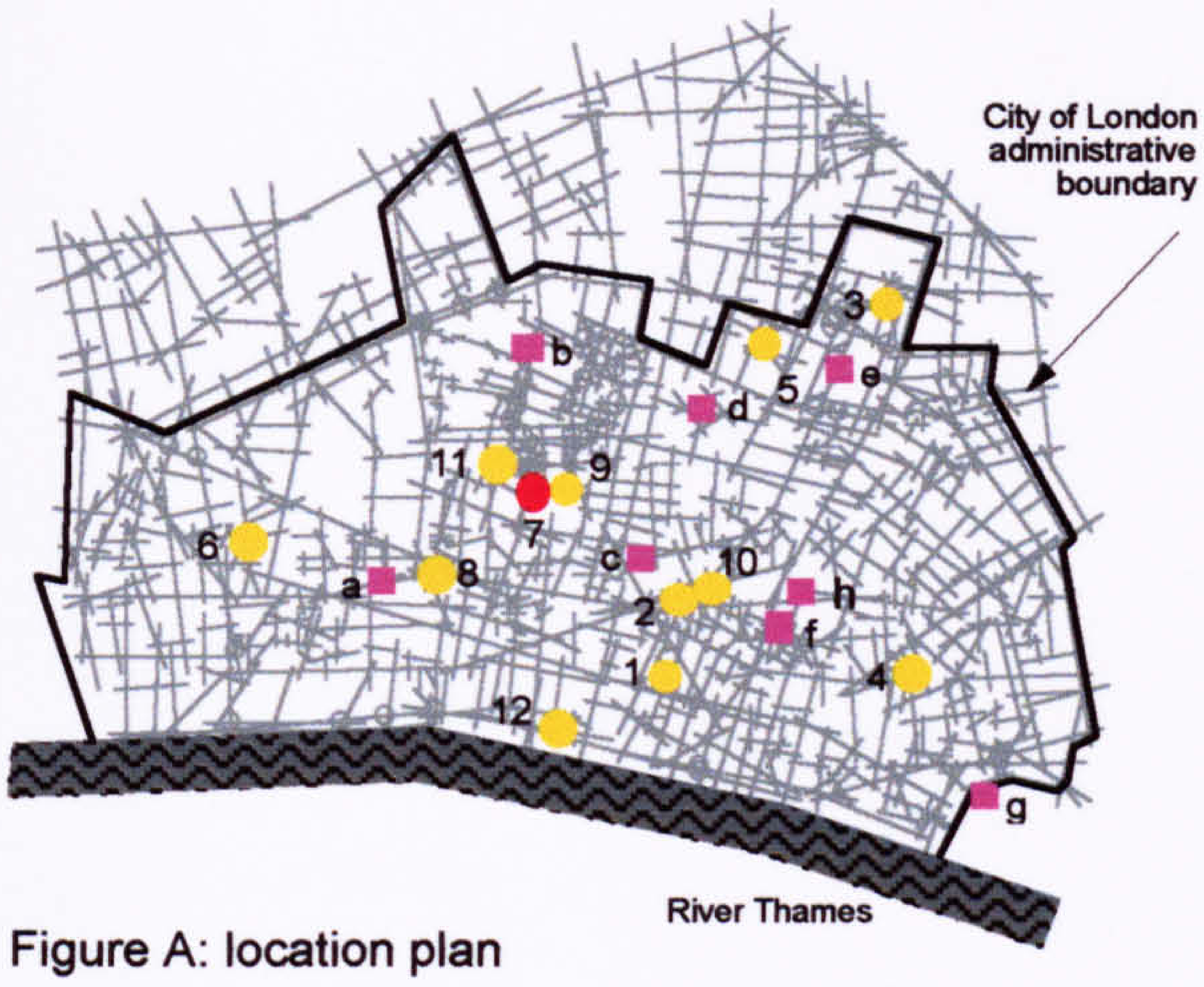


Figure A: location plan

Legend:

Public spaces

1. Abchurchyard
2. Bank Corner
3. Exchange Square
4. Fenchurch Place
5. Finsbury Av.
6. Fleet Place
7. Love Lane Corner
8. New Change/Cheapside
9. North Guildhall
10. Royal Exchange
11. St Anne & St Agnes
12. Whittington Gardens

Reference points

a. St. Paul's Cathedral
b. Barbican Centre
c. Bank of England
d. Finsbury Circus
e. Liverpool Station
f. Leadenhall Market
g. Tower of London
h. Lloyd's Building

public space
wine bar or pub
commercial outlets
access
designated seats

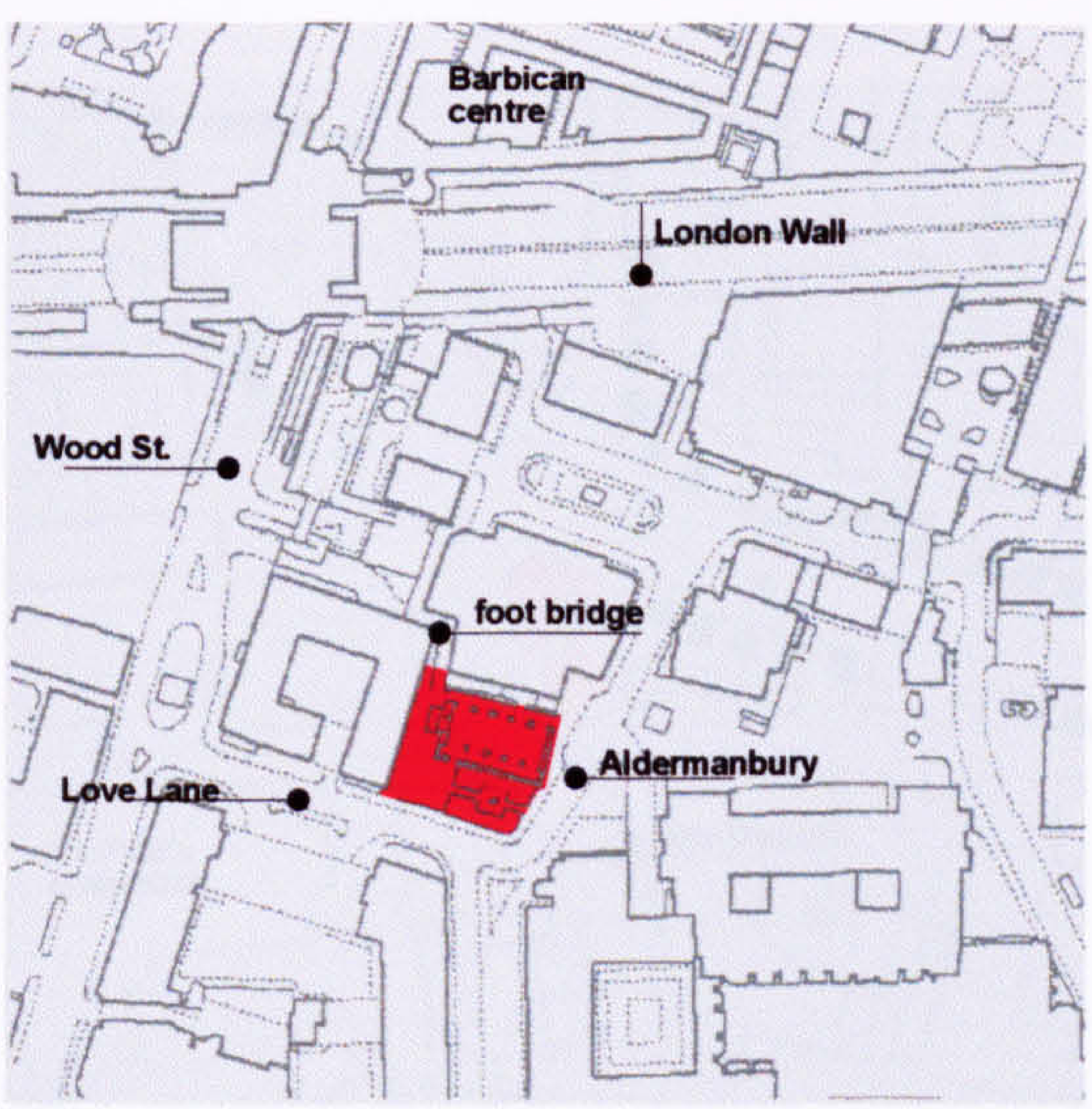


Figure B: site plan
scale: 1:3500

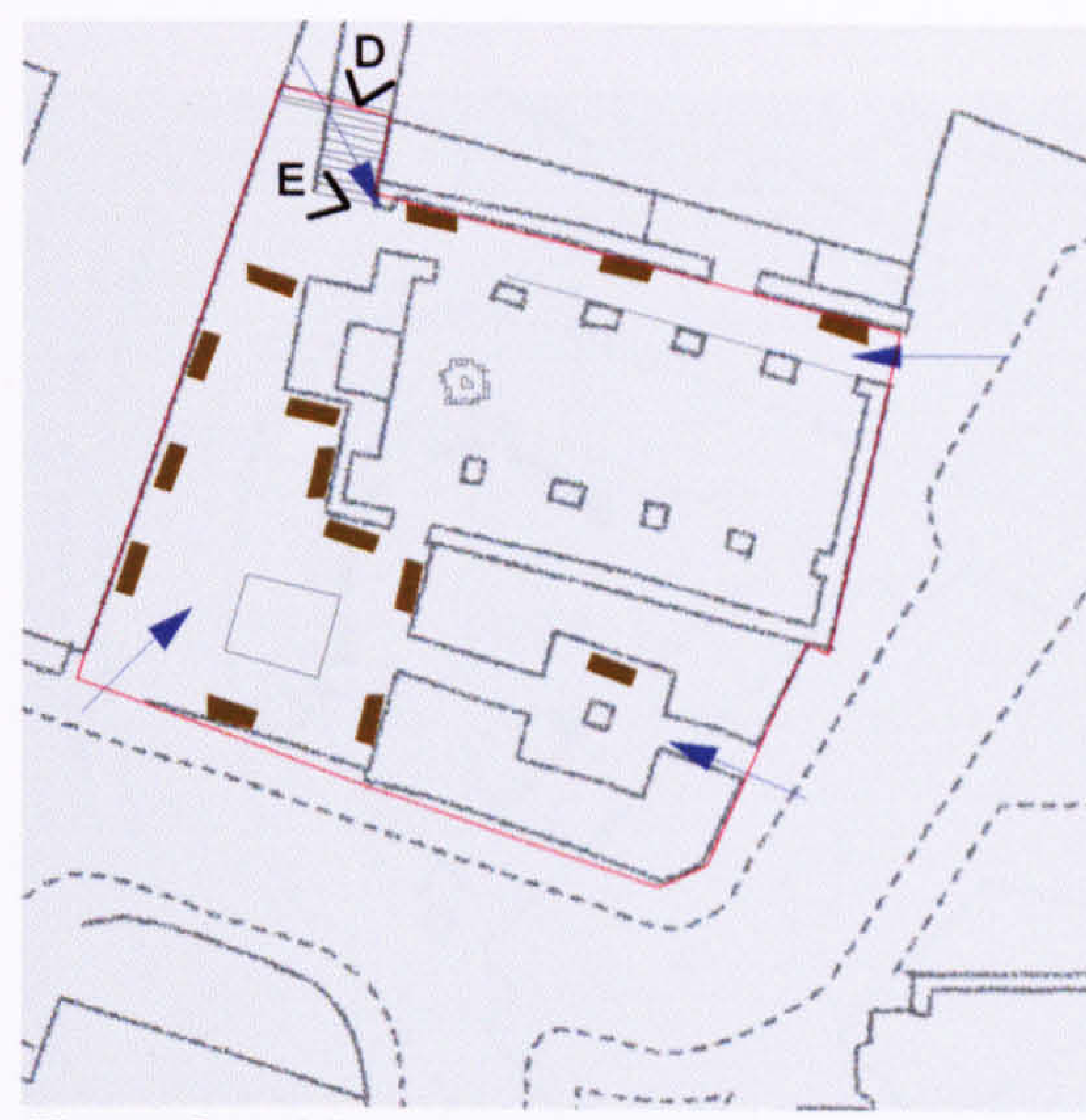


Figure C: public space plan
scale:1:750

Figure D

Figure E

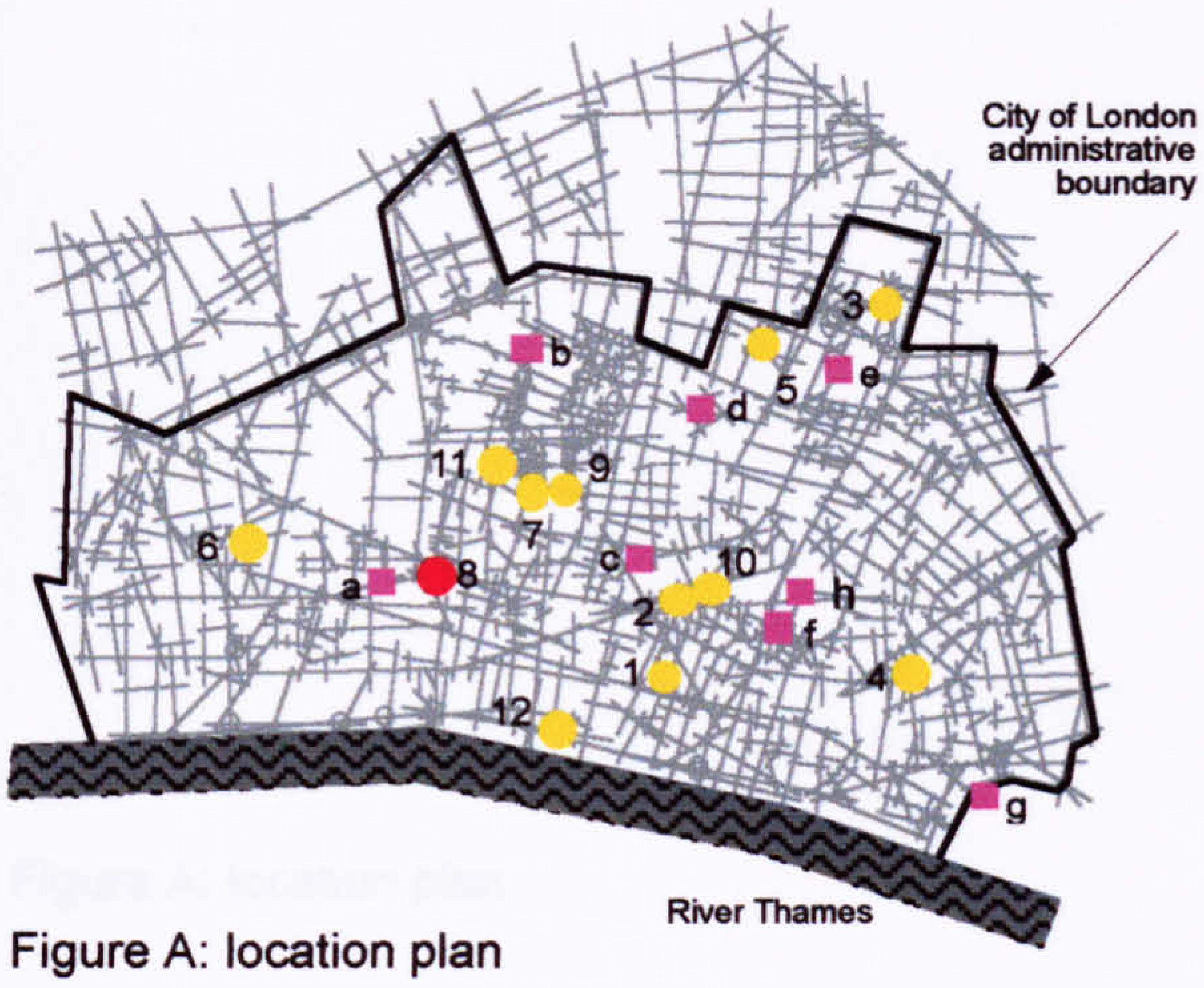


Figure A: location plan

Legend:

Public spaces

1. Abchurchyard
2. Bank Corner
3. Exchange Square
4. Fenchurch Place
5. Finsbury Av.
6. Fleet Place
7. Love Lane Corner
8. New Change/Cheapside
9. North Guildhall
10. Royal Exchange
11. St Anne & St Agnes
12. Whittington Gardens

Reference points

a. St. Paul's Cathedral
b. Barbican Centre
c. Bank of England
d. Finsbury Circus
e. Liverpool Station
f. Leadenhall Market
g. Tower of London
h. Lloyd's Building

public space
wine bar or pub
commercial outlets
access
designated seats

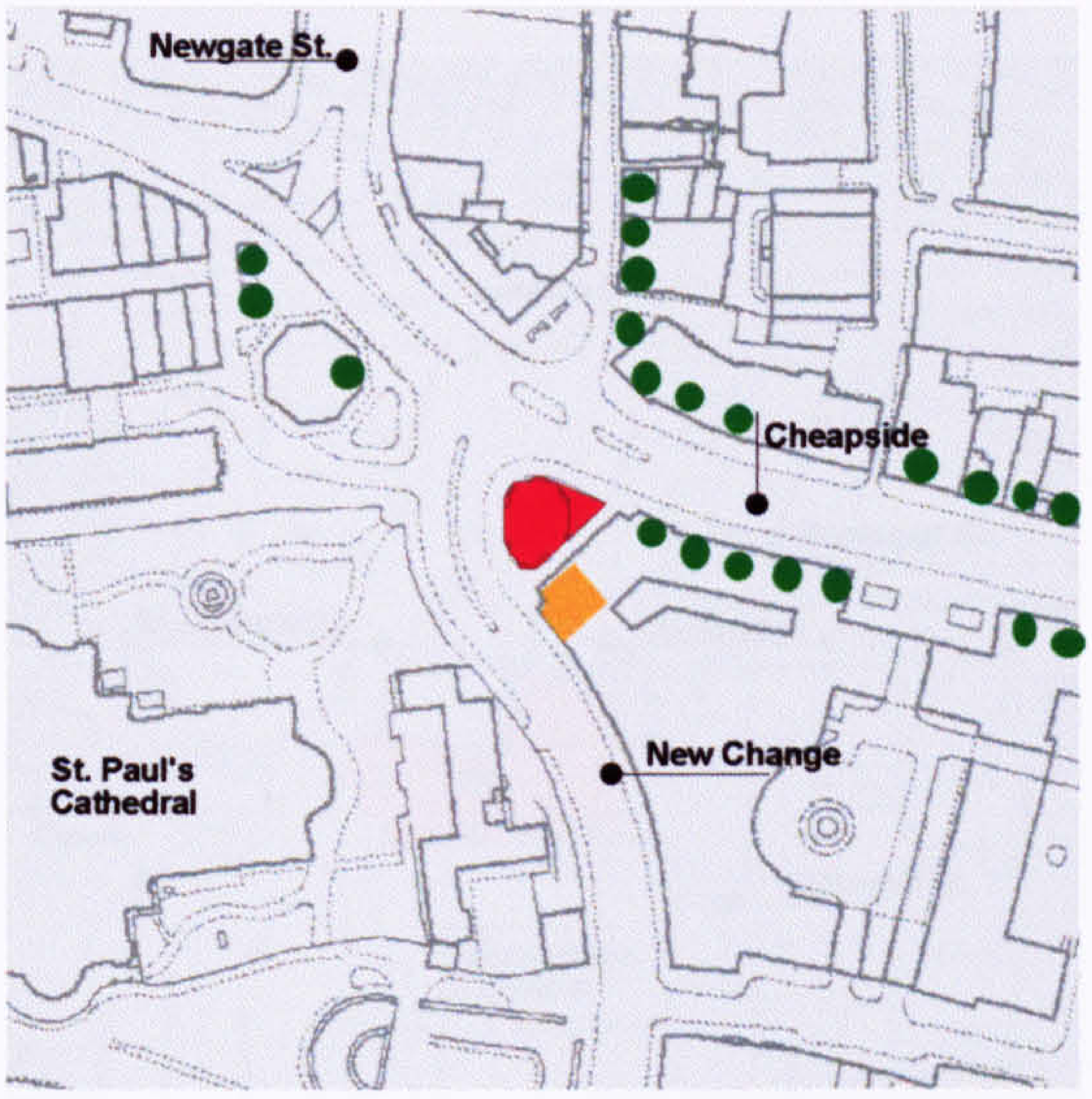


Figure B: site plan
scale: 1:3500

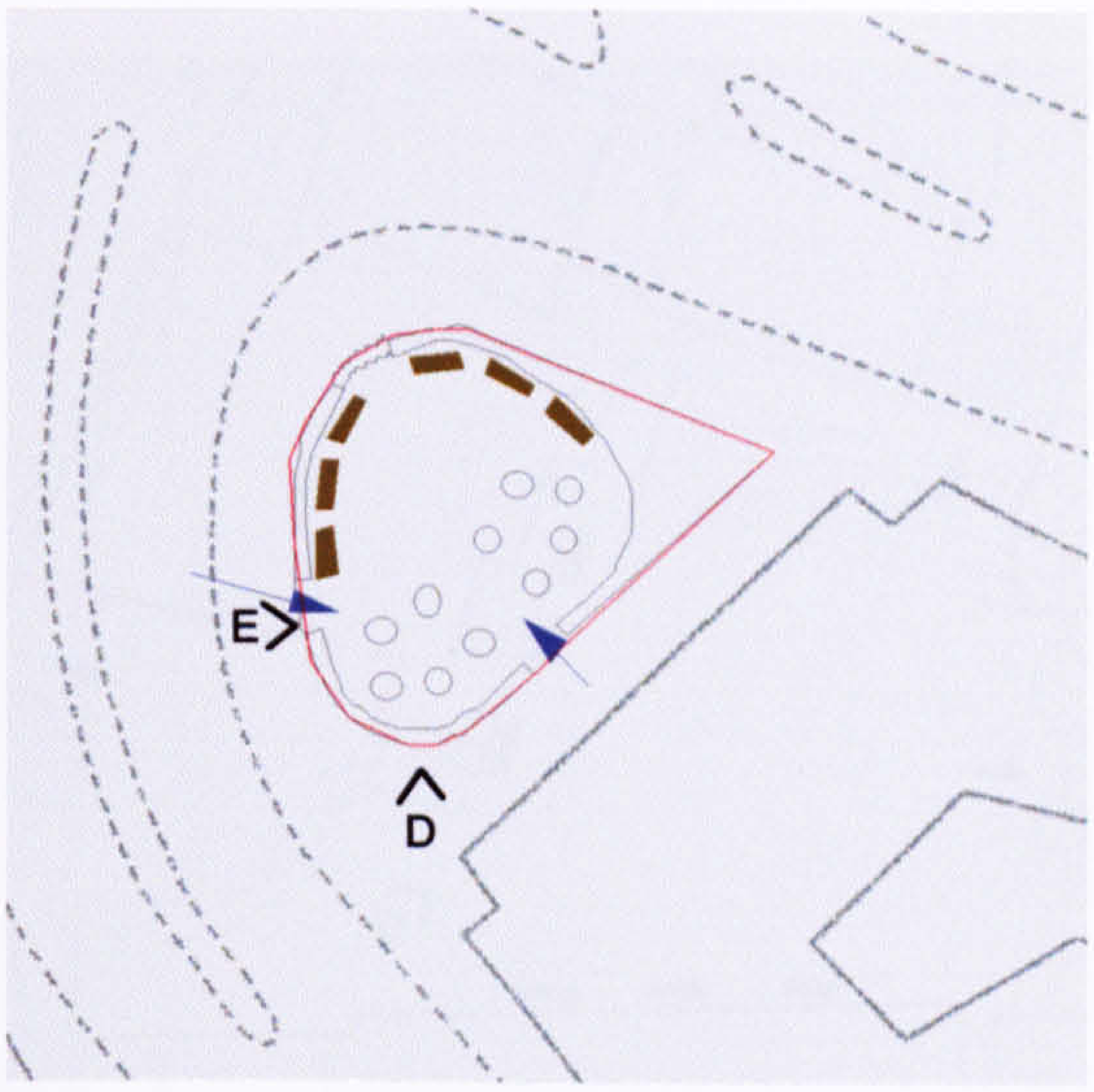


Figure C: public space plan
scale:1:750

Figure D

Figure E

Plate 4.9 - North Guildhall - plans and views

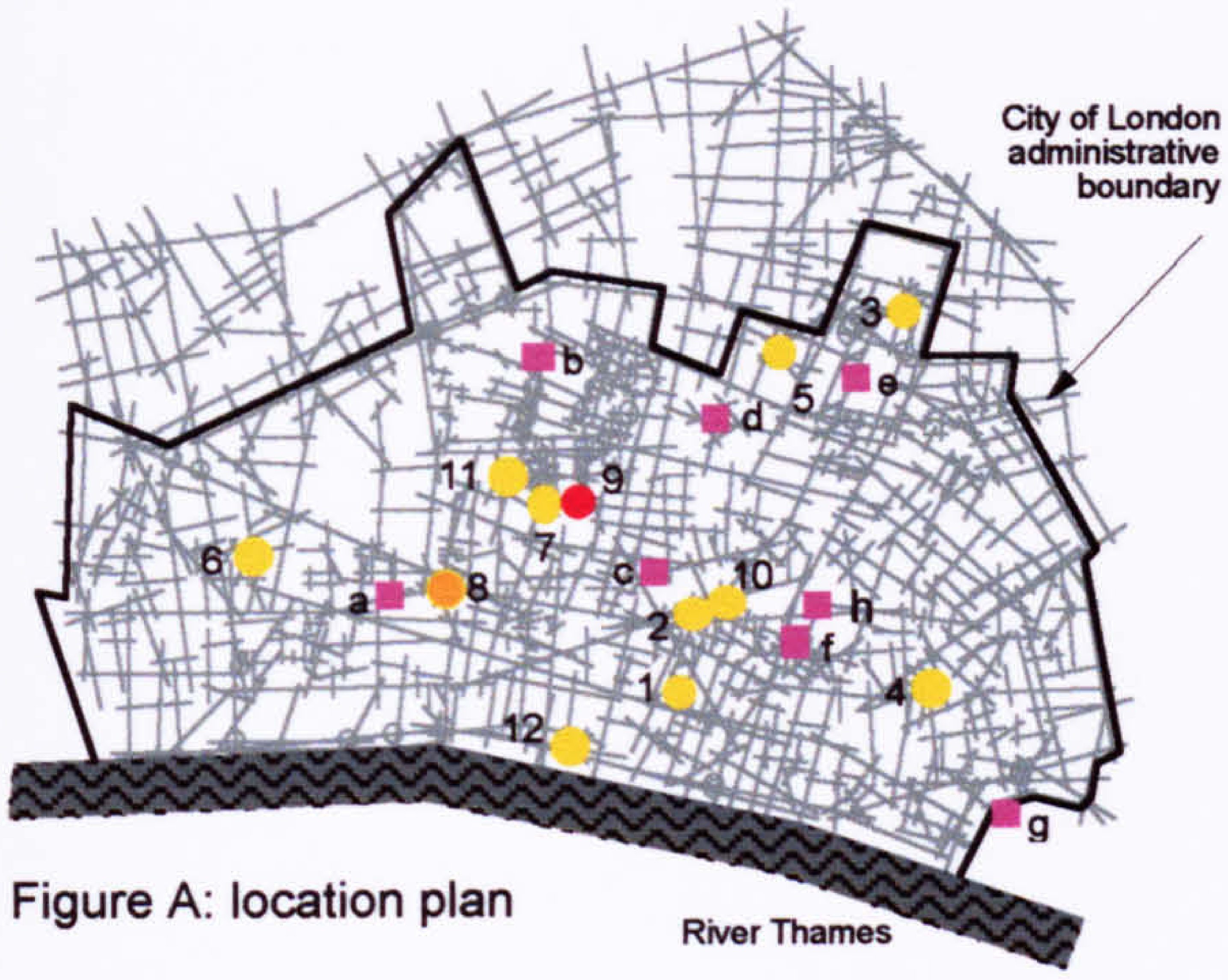


Figure A: location plan

Legend:

Public spaces

1. Abchurchyard
2. Bank Corner
3. Exchange Square
4. Fenchurch Place
5. Finsbury Av.
6. Fleet Place
7. Love Lane Corner
8. New Change/Cheapside
9. North Guildhall
10. Royal Exchange
11. St Anne & St Agnes
12. Whittington Gardens

Reference points

a. St. Paul's Cathedral
b. Barbican Centre
c. Bank of England
d. Finsbury Circus
e. Liverpool Station
f. Leadenhall Market
g. Tower of London
h. Lloyd's Building

public space
wine bar or pub
commercial outlets
access
designated seats

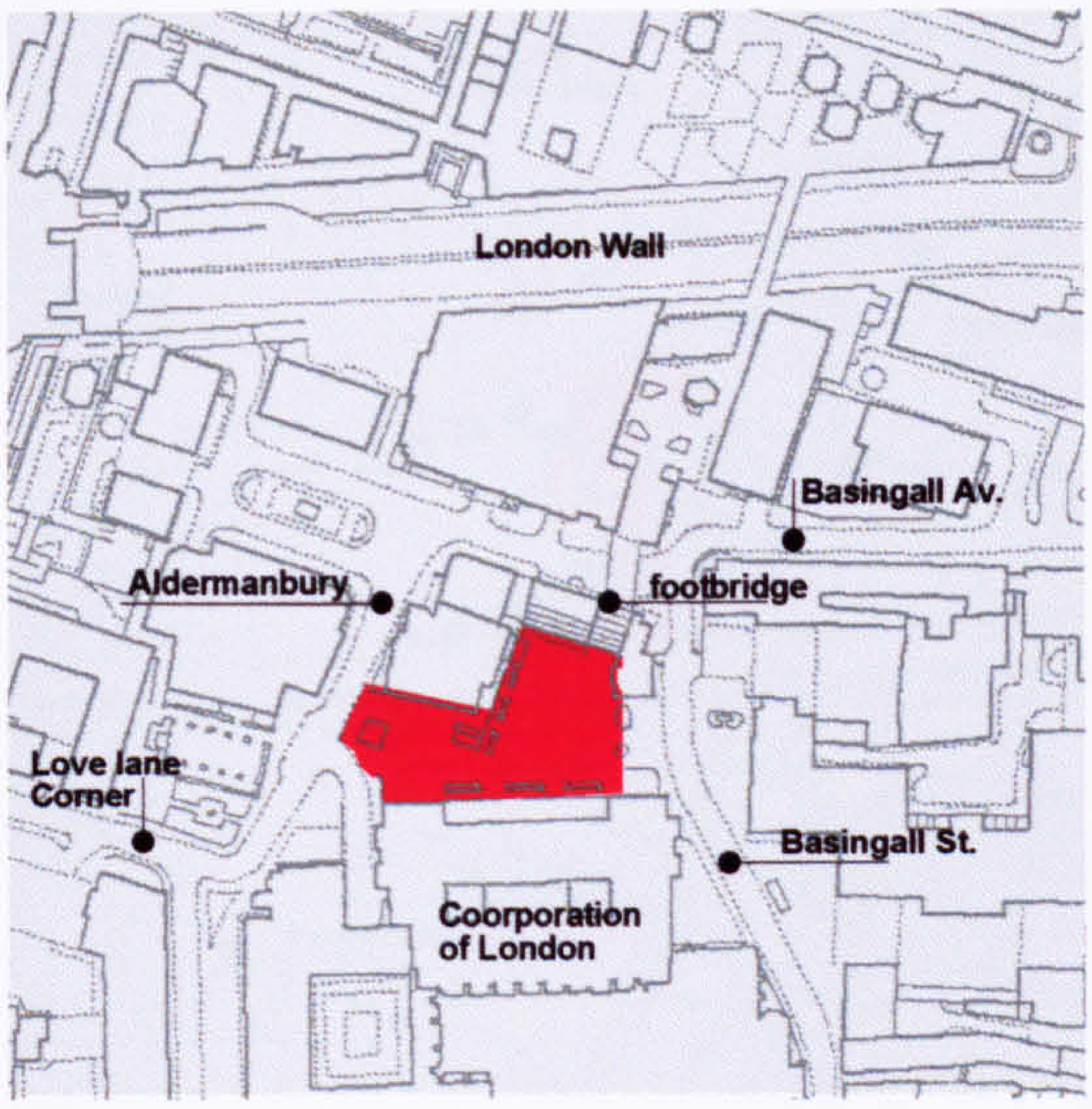


Figure B: site plan
scale: 1:3500

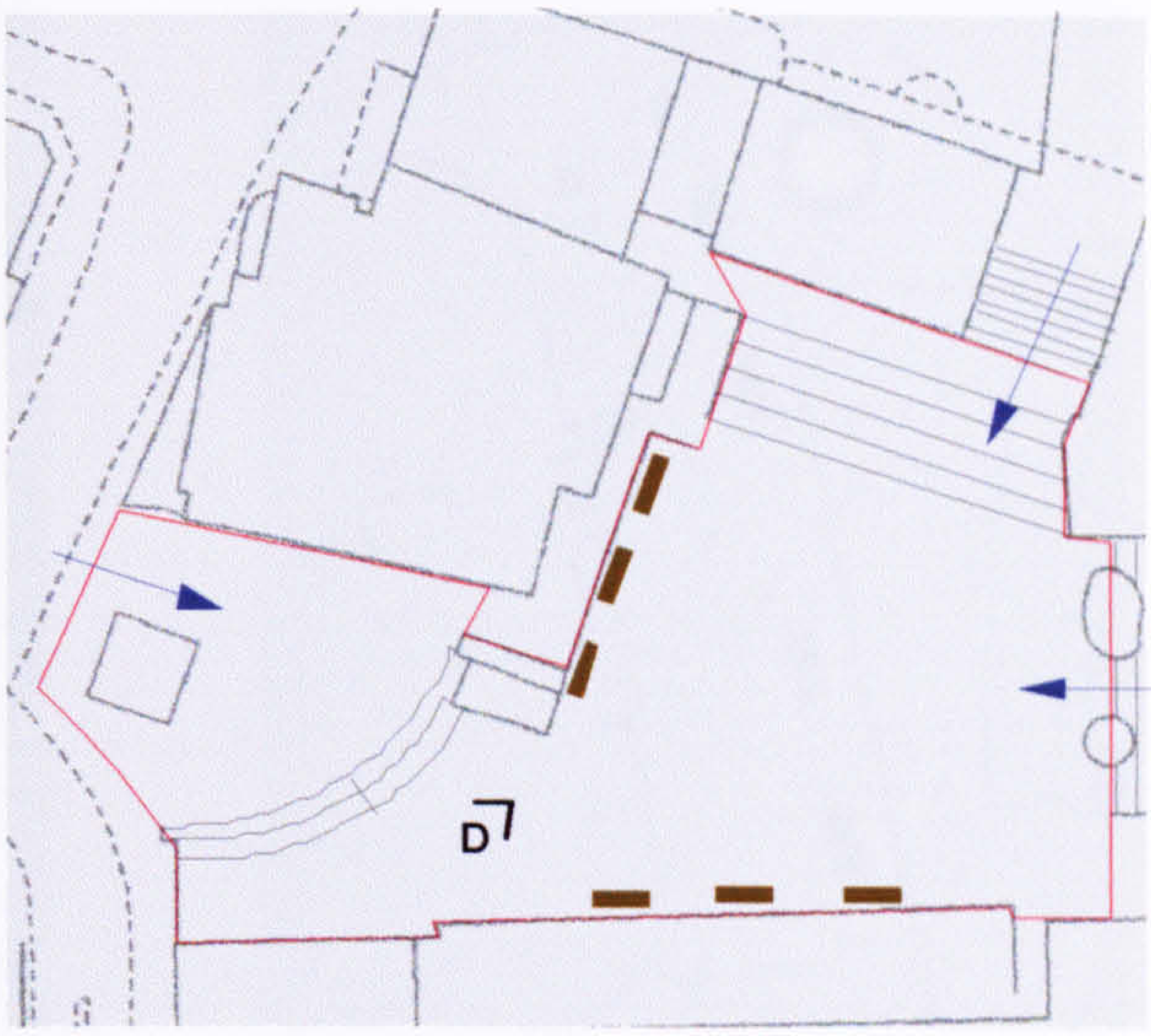


Figure C: public space plan
scale:1:850

Figure D

Plate 4.10 - Royal Exchange - plans and views

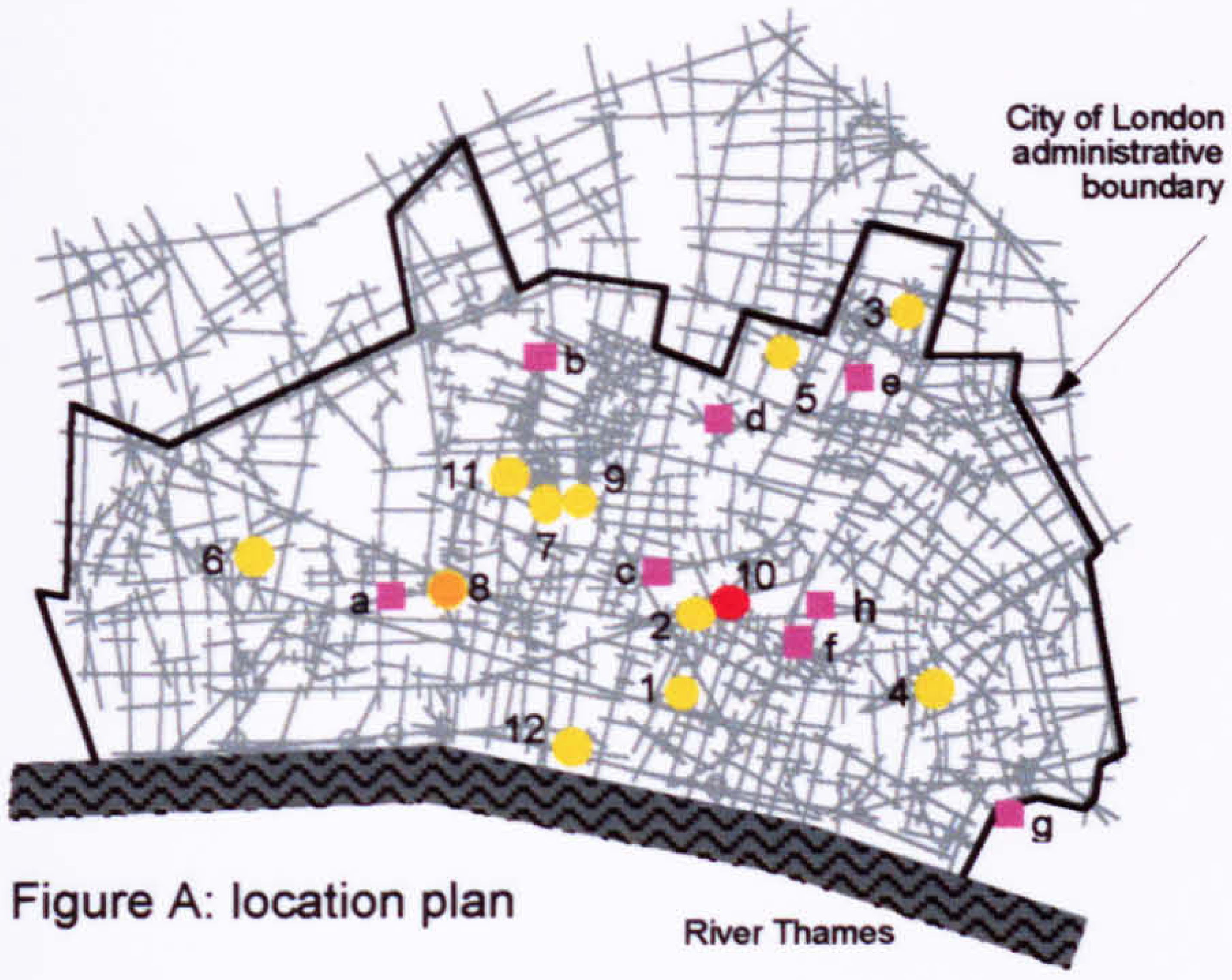


Figure A: location plan

Legend:

Public spaces

1. Abchurchyard
2. Bank Corner
3. Exchange Square
4. Fenchurch Place
5. Finsbury Av.
6. Fleet Place
7. Love Lane Corner
8. New Change/Cheapside
9. North Guildhall
10. Royal Exchange
11. St Anne & St Agnes
12. Whittington Gardens

Reference points

a. St. Paul's Cathedral
b. Barbican Centre
c. Bank of England
d. Finsbury Circus
e. Liverpool Station
f. Leadenhall Market
g. Tower of London
h. Lloyd's Building

public space
wine bar or pub
commercial outlets
access
designated seats

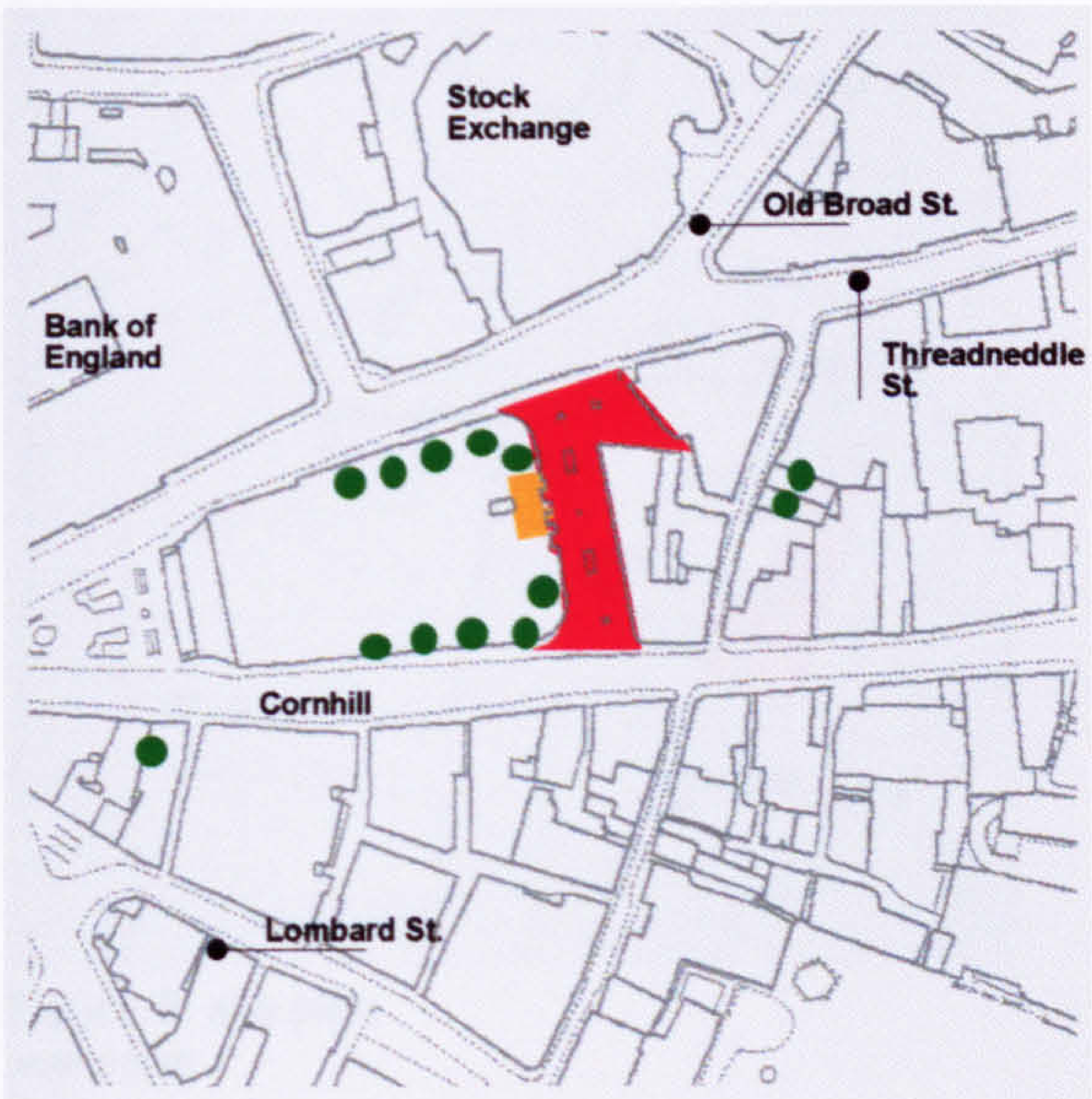


Figure B: site plan
scale: 1:3500

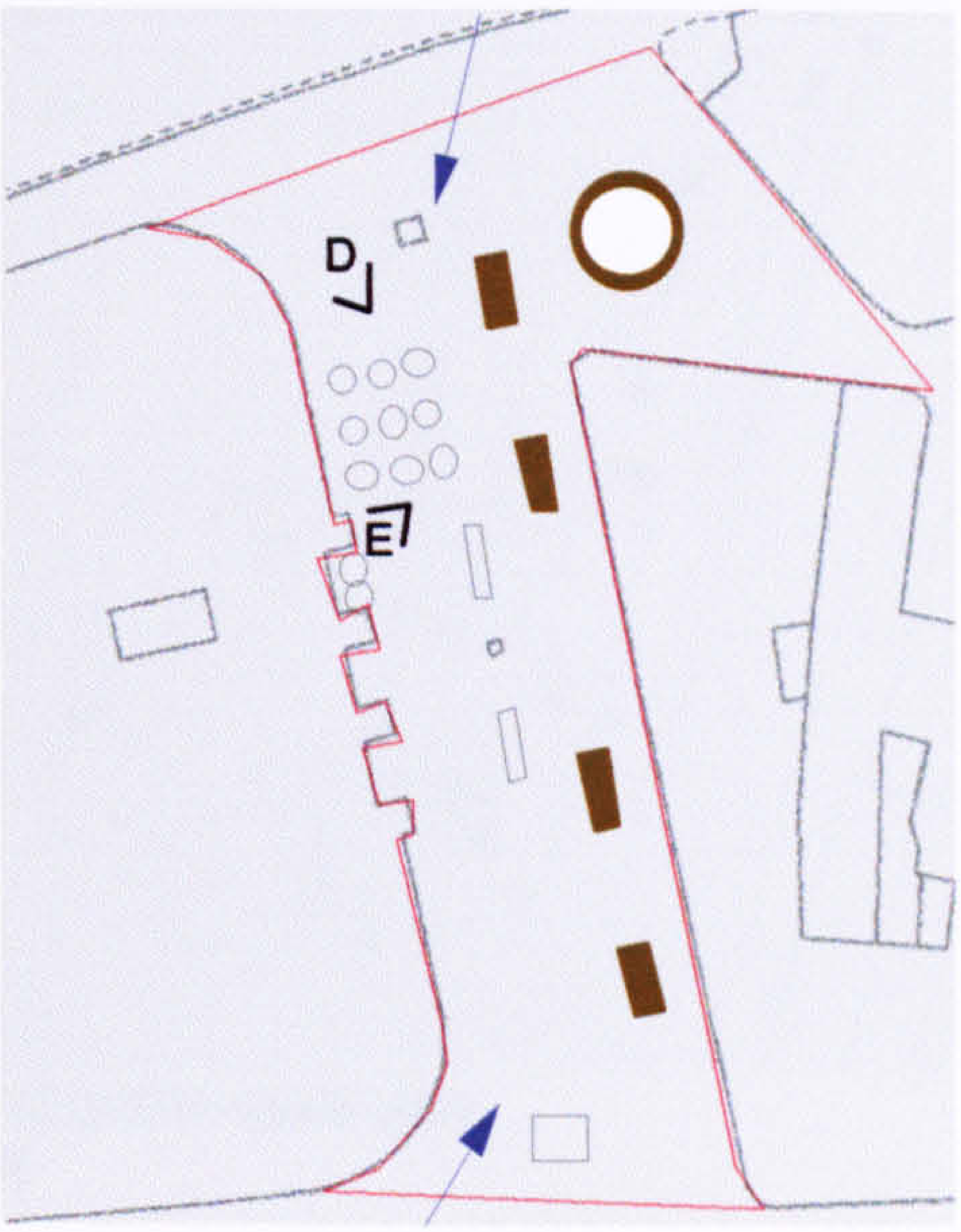


Figure C: public space plan
scale:1:900

Figure D

Figure E

Plate 4.11 - St. Anne & St. Agnes churchyard - plans and views

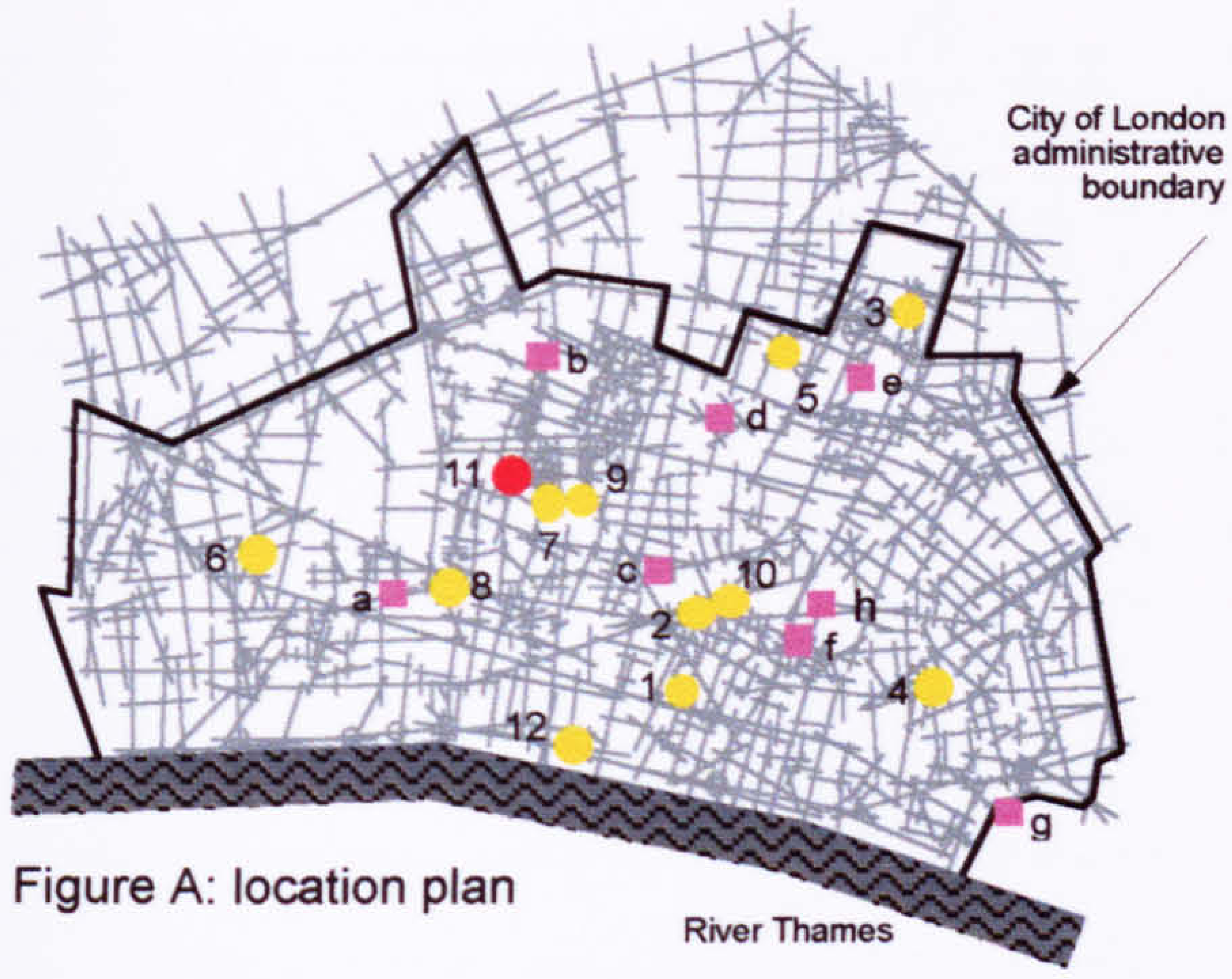


Figure A: location plan

Legend:

Public spaces

1. Abchurchyard
2. Bank Corner
3. Exchange Square
4. Fenchurch Place
5. Finsbury Av.
6. Fleet Place
7. Love Lane Corner
8. New Change/Cheapside
9. North Guildhall
10. Royal Exchange
11. St Anne & St Agnes
12. Whittington Gardens

Reference points

a. St. Paul's Cathedral
b. Barbican Centre
c. Bank of England
d. Finsbury Circus
e. Liverpool Station
f. Leadenhall Market
g. Tower of London
h. Lloyd's Building

public space
wine bar or pub
commercial outlets
access
designated seats

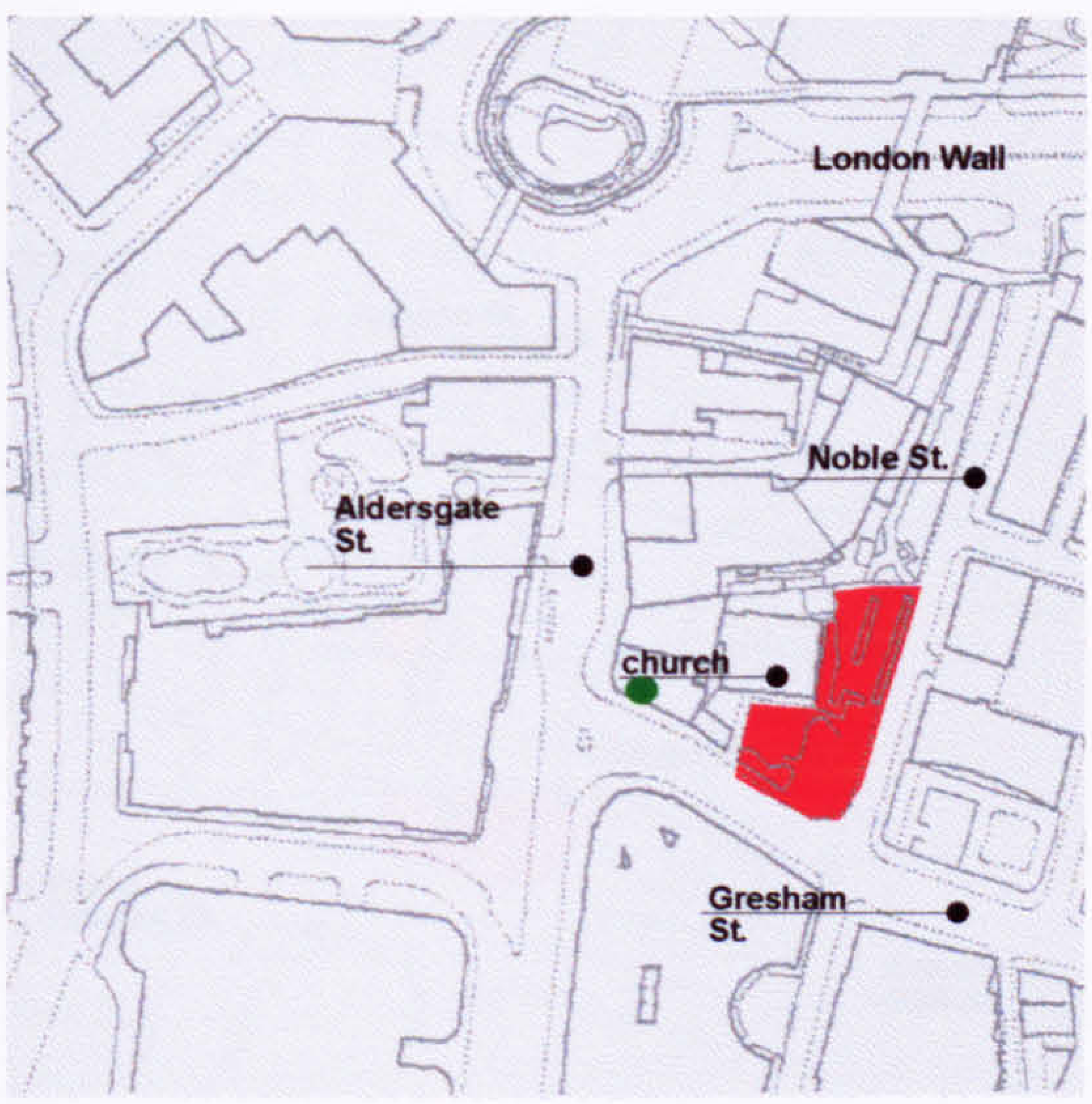


Figure B: site plan
scale: 1:3500

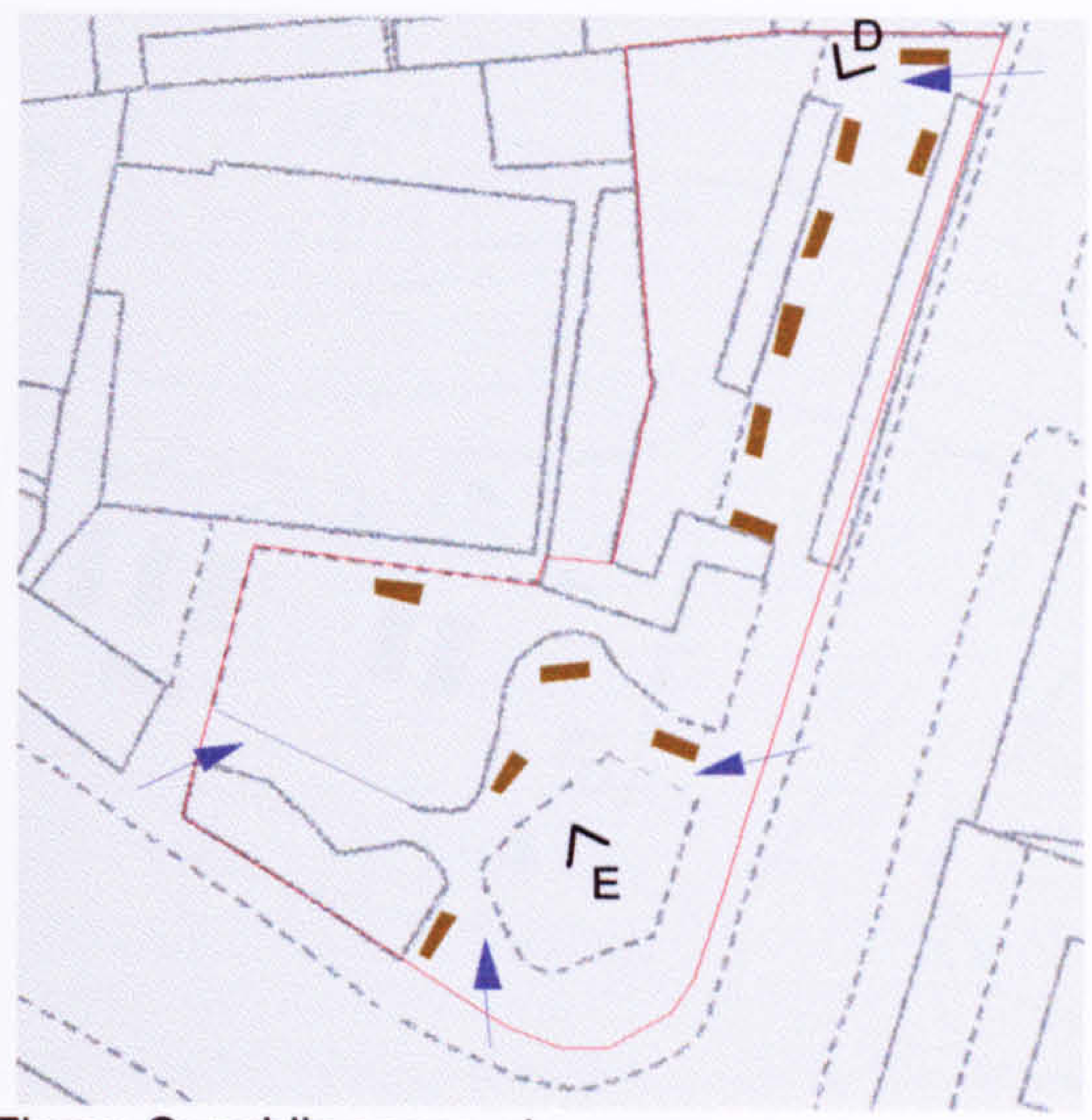


Figure C: public space plan
scale:1:750

Figure D

Figure E

Plate 4.12 - Whittington Gardens - plans and views

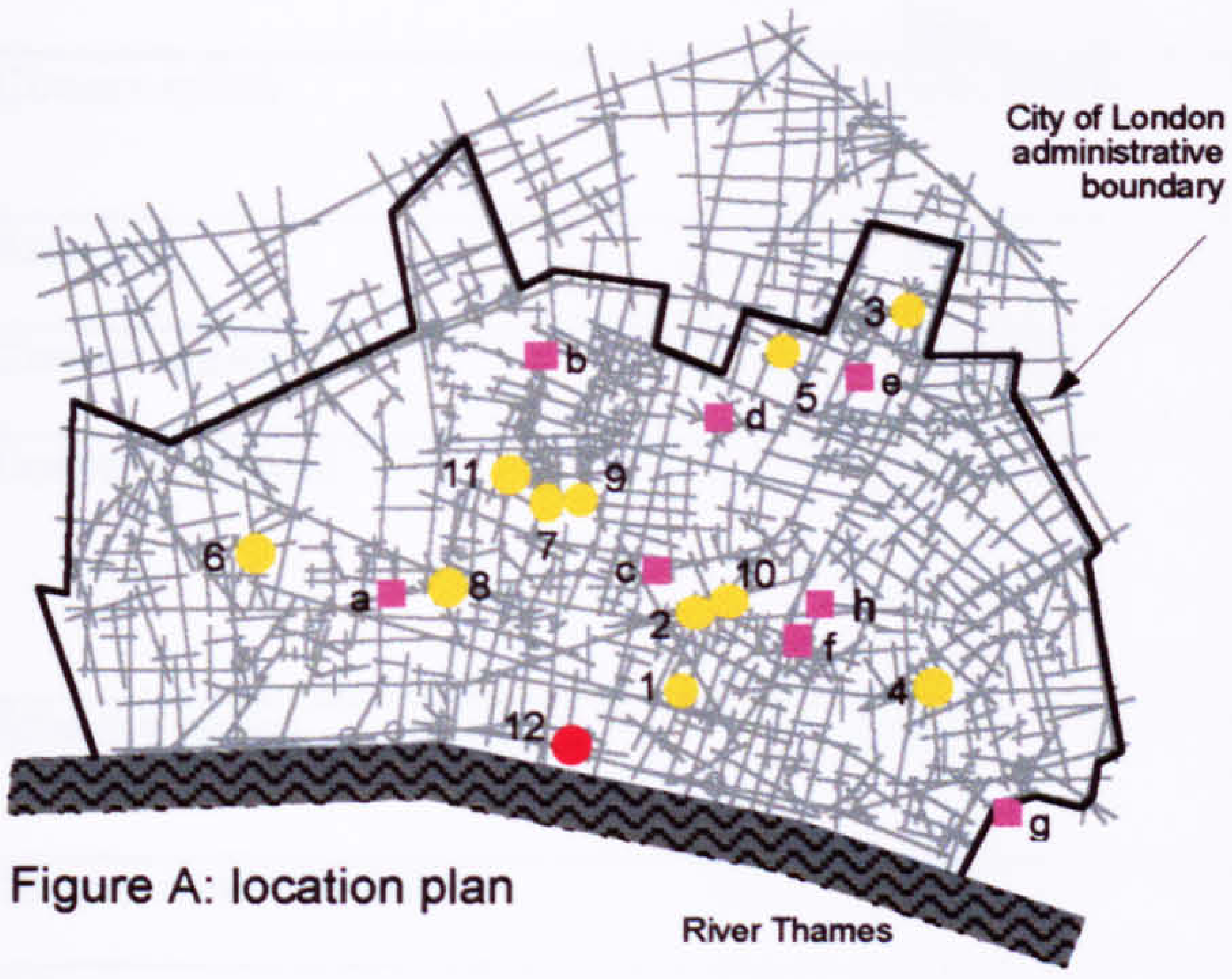


Figure A: location plan

Legend:

Public spaces

1. Abchurchyard
2. Bank Corner
3. Exchange Square
4. Fenchurch Place
5. Finsbury Av.
6. Fleet Place
7. Love Lane Corner
8. New Change/Cheapside
9. North Guildhall
10. Royal Exchange
11. St Anne & St Agnes
12. Whittington Gardens

Reference points

a. St. Paul's Cathedral
b. Barbican Centre
c. Bank of England
d. Finsbury Circus
e. Liverpool Station
f. Leadenhall Market
g. Tower of London
h. Lloyd's Building

public space
wine bar or pub
commercial outlets
access
designated seats

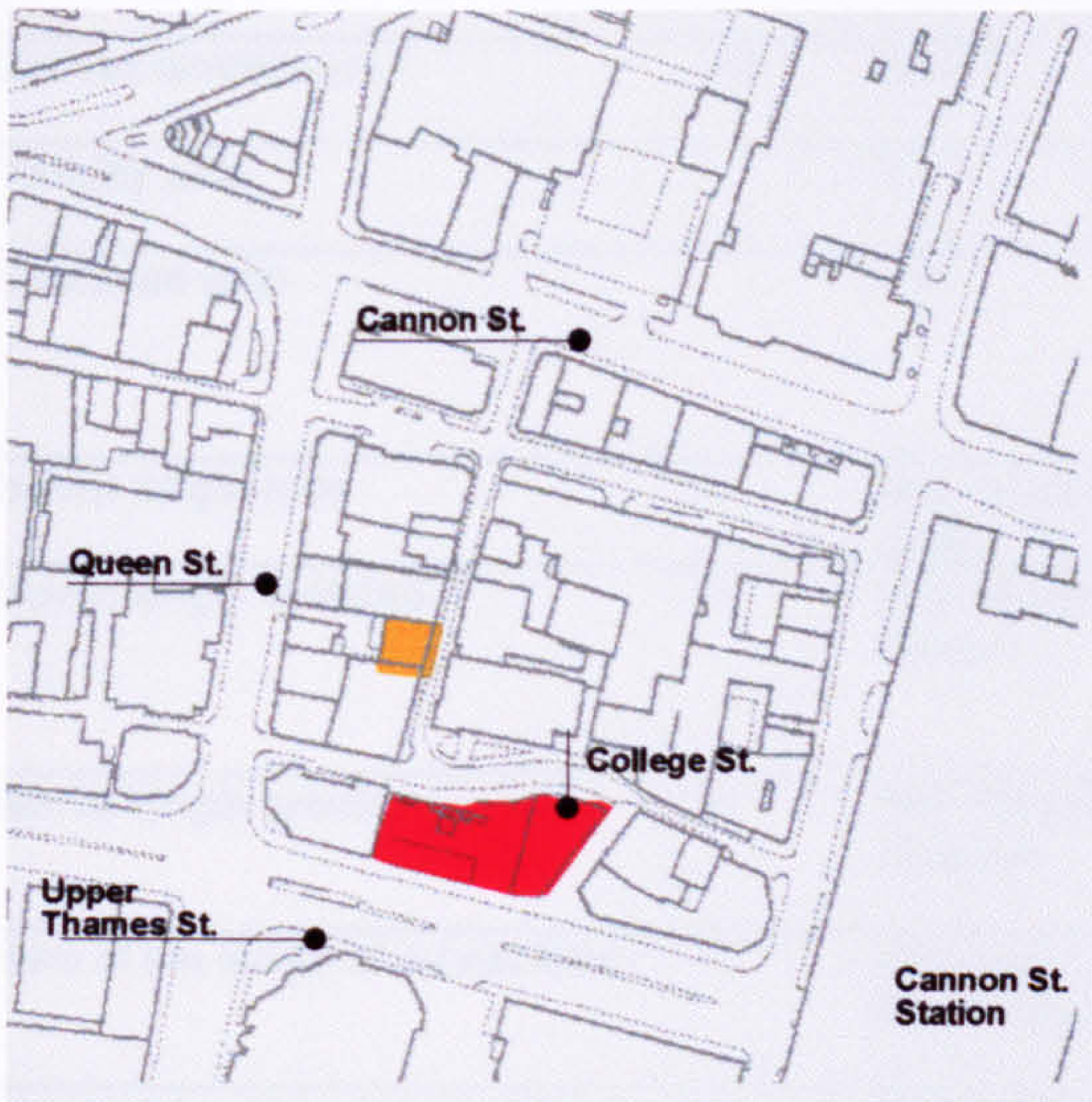


Figure B: site plan
scale: 1:3500

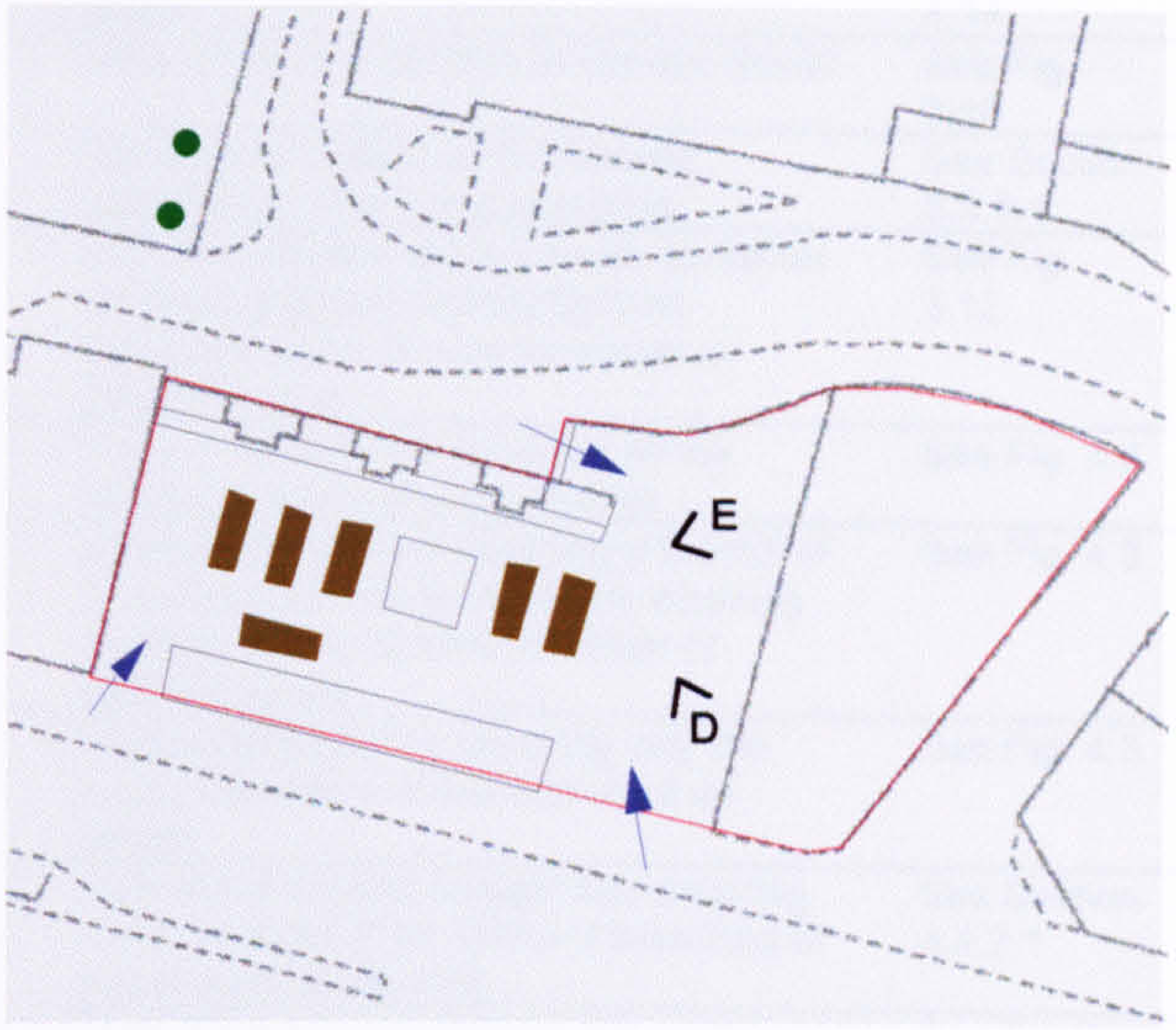


Figure C: public space plan
scale:1:750

Figure D

Figure E

Table 4.2. Public spaces in the City of London: Description of measurements (1/2)

Measurement	Unit	Abbreviation	Description	Notes
Convex space		cvx. space	A polygon where no line drawn between any two points in space goes outside the space	See Section 2.4.1
Axial line		ax.line	Longest and straight line of accessibility and visibility	See Section 2.4.1
Convex isovist		Isovist or isov.	Set of all points visible from with in the selected convex space	See Section 2.4.1
Convex container		cc	Biggest convex element with regards to its physical area that could be inserted into the open space, limited b the façades of the buildings but omitting elements such as pavements or vegetation	See Section 4.4.1.1
Effective space		es	It is the public space, which is effectively used by the public for informal static actives	See Section 4.4.1.2
Convex container area	m2	cc.A	Measurement of the surface of convex container	See Plate 4.13
Effective space area	m2	es.A	Measurement of the surface of effective space	See Plate 4.14
Convex isovist area	m2	Isov. A	Measurement of surface of convex isovist	See Fig. 3.10
Visibility ratio		V.R.	Isovist area divided by the convex container or effective space area	See Section 3.3.3.1
Enclosure ratio		E.R	Unbuilt perimeter of the convex container or effective space divided by built perimeter of the convex container or effective space	See Fig. 3.12
Isovist length total	m	Isov. length (total)	Longest straight line covering all the verities of a branch of an isovist	See Fig. 4.3
Isovist length selected	m	Isov. length (selec)	Longest straight line covering a branch of an isovist that had an axial line crossing the body of the convex container or effective space	See Fig. 4.3
Isovist length special	m	Isov. length (special)	Longest straight line covering only the major segment s of the branch of an isovist	See Fig. 4.3
Sum of the length of isovist total	m	Sum isov. length (total)	Sum of the longest straight line covering all the vertices of all different branches of the convex isovist total	See Section 4.4.2.1
Mean of the sum of the length of the isovist total	m	Mean sum isov. length (total)	Sum of the longest straight line covering all the vertices of all different branches of the convex isovist total divided by the number of lengths of the isovist total	See Section 4.4.2.1
Sum of the length of isovist selected	m	Sum isov. length (selec)	Sum of the longest straight line covering all different branches of the convex isovist selected	See Section 4.4.2.1
Mean of the sum of the length of the isovist selected	m	Mean sum isov. length (selec)	Sum of the longest straight line covering all different branches of the convex isovist selected divided by the number of lengths of the isovist selected	See Section 4.4.2.1
Sum of the length of isovist special	m	Sum isov. length (special)	Sum of the longest straight line covering all different branches of the convex isovist special	See Section 4.4.2.1
Mean of the sum of the length of the isovist special	m	Mean sum isov. length (special)	Sum of the longest straight line covering all different branches of the convex isovist special divided by the number of lengths of the isovist special	See Section 4.4.2.1
Sum of the length the axial lines	m	Sum axial lines length	Sum of the (metric) length of axial lines	See Section 3.3.3.2
Mean of the sum of the length of the axial lines	m	Mean sum ax.lines length	Sum of the (metric) length of axial lines divided by the number of axial lines	See Section 3.3.3.2
Global integration value		Rn	Relative depth of an axial line to all other lines of the system	See Section 2.4.2
Local integration value		R3	Relative depth of an axial line to all other lines of the system up to three steps away	See Section 2.4.2

Table 4.2. Public spaces in the City of London: Description of measurements (2/2)

Convergent axial line	C line	Axial line that crosses the convex container or effective space but terminates within the convex container or effective space	See Fig. 3.13
Transverse axial line	T line	Axial line that crosses the convex container or effective space but continues further away	See Fig. 3.14
Peripheric axial line	P line	Axial line that crosses at the edges of the convex container or effective space, and continues further away	See Fig. 3.15
Local strategic value	Local strat. value	Sum of the local integration value of all axial lines that interface with the convex container or effective space	See Section 3.3.3.2
Strategic value	Strat. value	Sum of the global integration value of all axial lines that interface with the convex container or effective space	See Sections 2.5 and 3.3.3.2
Intersection points	Inters.pts	Intersection of two or more axial lines which interface with the convex container or effective space	See Section 3.3.3.2.1
Global integration value of main line	Rn main line	Axial line with the highest global integration value that interface with the convex container or effective space	See Section 2.5
Global integration value of convex container relativised	Rn value ccR	Global integration value of the convex container divided by the mean global integration value of study area	See Section 4.4.2.3
Global integration value of effective space relativised	Rn value esR	Global integration value of the effective space divided by the mean global integration value of study area	See Section 4.4.2.3

Table 4.3. Convex container general data table

Names	Type	Pubs Wine bars	Convex container area	Isovist area	Visibility ratio	Enclo sure ratio
Abchuchyard	former churchyard	yes	383.60	1137.55	2.97	6.76
Bank Corner	building develpment	no	2453.16	39742.50	16.20	1.89
Exchange Sq.	office complex	yes	5161.47	9067.39	1.76	0.41
Fenchurch Place	building develpment	yes	1711.09	2753.67	1.61	2.83
Finsbury Av.	office complex	yes	2825.51	14403.00	5.10	2.62
Fleet Place	office complex	yes	1613.14	7324.49	4.54	1.63
Love Lane	former church site	no	1865.76	7419.80	3.98	0.95
New Change	building develpment	yes	3462.63	38453.90	11.11	0.62
North Guildhall	building develpment	no	1079.74	5473.68	5.07	2.49
Royal Exch.	building develpment	yes	1394.22	28201.80	20.23	1.12
St Anne St Agnes	former churchyard	no	1571.36	9047.25	5.76	1.35
Whittington Gds.	former churchyard	yes	2735.06	19950.10	7.29	1.97

Names	Sum isov. length total	Mean isov. length total	Sum isov. length selected	Mean isov. length selected	Sum isov. length special	Mean isov. length special	Sum axial lines length	Mean sum ax.lines length
Abchuchyard	236.60	59.15	196.95	65.65	208.60	69.53	251.41	125.71
Bank Corner	3338.42	256.80	1593.26	398.31	2629.43	438.24	2184.61	728.20
Exchange Sq.	915.46	101.72	810.87	101.36	732.84	104.69	1410.84	201.55
Fenchurch Pl.	315.18	63.04	260.23	65.06	260.23	65.06	539.44	134.86
Finsbury Av.	1385.08	173.14	1052.90	175.48	1052.9	175.48	964.16	192.83
Fleet Place	568.42	94.74	547.06	109.41	547.06	109.41	605.34	201.78
Love Lane	763.47	95.43	452.16	90.43	502.15	100.43	651.72	162.93
New Change	2992.09	249.34	2246.59	320.94	2191.02	365.17	2853.41	407.63
North Guildhall	672.70	84.09	198.42	99.21	380.97	95.24	371.02	185.51
Royal Exch.	2191.16	219.12	2033.93	254.24	1973.20	281.89	2609.32	434.89
St Anne	1226.27	136.25	653.43	163.36	653.43	163.36	995.89	331.96
Whittington Gs	1744.27	193.81	1203.69	240.74	1203.69	240.74	1520.68	380.17

Names	N° (C) ax. line	N° (T) ax line	N° (P) ax. line	N° all ax. line	Sum R3 (C) axial lines	Sum R3 (T) axial lines	Sum R3 (P) axial lines	Local strat. value	Sum Rn (C) axial lines	Sum Rn (T) axial lines	Sum Rn (P) axial lines	Strat. value
Abchuchyard	1	•	1	2	1.48	•	4.03	5.51	1.27	•	1.46	2.73
Bank Corner	•	•	3	3	•	•	16.28	16.28	•	•	4.63	4.63
Exchange Sq.	5	1	1	7	16.84	3.53	2.81	23.18	5.93	1.15	1.16	8.24
Fenchurch Pl.	4	•	•	4	11.84	•	•	11.84	4.95	•	•	4.95
Finsbury Av.	5	•	•	5	15.60	•	•	15.60	6.02	•	•	6.02
Fleet Place	•	2	1	3	•	6.85	3.54	10.39	•	2.71	1.37	4.08
Love Lane	3	1	•	4	8.84	3.50	0.00	12.34	3.64	1.32	•	4.96
New Change	4	2	1	7	18.09	8.88	5.82	32.79	5.81	2.88	1.51	10.20
N. Guildhall	1	1	•	2	2.87	3.00	•	5.87	1.25	1.19	•	2.44
Royal Exch.	2	1	3	6	7.39	3.41	16.28	27.08	2.76	1.37	4.63	8.76
St Anne	1	•	2	3	4.38	•	7.80	12.18	1.41	•	2.71	4.12
Whittington	3	•	1	4	9.86	•	5.61	15.47	3.99	•	1.44	5.43

Names	Rn value main line	Rn value convex container	Mean Rn value "London"	Rn value cc. R	Total n° intersect. points	2 axial lines/ point	3 axial lines/ point
Abchuchyard	1.4611	1.3822	1.0328	1.3383	1	1	•
Bank Corner	1.5549	1.3967	1.0328	1.3523	1	1	•
Exchange Sq.	1.2417	1.3974	1.0328	1.3531	8	7	1
Fenchurch Place	1.2582	1.1681	1.0328	1.1310	4	3	1
Finsbury Av.	1.2790	1.1377	1.0328	1.1015	4	2	2
Fleet Place	1.3870	1.2575	1.0328	1.2176	2	2	•
Love Lane	1.3212	1.1689	1.0328	1.1318	4	4	•
New Change	1.5507	1.4050	1.0328	1.3604	12	10	2
North Guildhall	1.2523	1.1168	1.0328	1.0813	1	1	•
Royal Exch.	1.5549	1.3974	1.0328	1.3531	4	3	1
St Anne St Agnes	1.4063	1.2691	1.0328	1.2287	2	2	•
Whittington Gds.	1.4400	1.2753	1.0328	1.2348	4	4	•

Table 4.4. Effective space general data table

Names	Type	Pubs Wine bars	Effective space area	Isovist area	Visibility ratio	Enclo sure ratio
Abchuchyard	former churchyard	yes	322.99	1024.66	3.17	2.82
Bank Corner	building develpment	no	1019.85	17951.10	17.6	0.59
Exchange Sq.	office complex	yes	6371.41	8114.85	1.27	3.37
Fenchurch Place	building develpment	yes	830.98	3595.39	4.33	0.22
Finsbury Av.	office complex	yes	2957.79	14331.90	4.85	3.34
Fleet Place	office complex	yes	1493.24	7459.59	5.00	2.82
Love Lane	former church site	no	918.74	7419.72	8.08	1.16
New Change	building develpment	yes	288.61	22541.50	78.1	0
North Guildhall	building develpment	no	1666.82	7144.56	4.29	3.18
Royal Exch.	building develpment	yes	1170.33	12157.95	10.39	2.56
St Anne St Agnes	former churchyard	no	1095.90	9213.54	8.41	0.61
Whittington Gds.	former churchyard	yes	984.30	19263.00	19.57	0.13

Names	Sum isov. length total	Mean isov. length total	Sum isov. length selected	Mean isov. length selected	Sum isov. length special	Mean isov. length special	Sum axial lines length	Mean sum ax.lines length
Abchuchyard	197.63	65.88	197.63	65.88	197.63	65.88	51.26	51.26
Bank Corner	1378.66	137.87	978.49	244.62	916.11	305.37	771.32	385.66
Exchange Sq.	867.95	96.44	770.59	96.32	697.99	99.71	1244.86	207.48
Fenchurch Pl.	331.59	66.32	280.01	70.00	280.01	70.00	317.32	158.66
Finsbury Av.	1383.77	172.97	1051.58	175.26	1051.58	175.26	964.16	192.83
Fleet Place	562.94	93.82	541.73	108.35	541.73	108.35	605.34	201.78
Love Lane	546.66	91.11	480.01	96.00	480.01	96.00	336.84	168.42
New Change	2012.21	201.22	1609.4	229.91	1528.91	254.82	456.45	228.23
North Guildhall	749.98	83.33	120.77	60.39	463.67	92.73	361.25	180.62
Royal Exch.	1419.43	141.94	1314.83	164.35	1262.65	180.38	424.72	141.57
St Anne	1258.07	139.79	646.55	161.64	646.55	161.64	410.07	205.04
Whittington Gs	1640.34	182.26	1086.53	217.31	1086.53	217.31	195.27	195.27

Names	N° (C) ax. line	N° (T) ax line	N° (P) ax. line	N° all ax. line	Sum R3 (C) axial lines	Sum Rn (T) axial lines	Sum R3 (P) axial lines	Local strat. value	Sum Rn (C) axial lines	Sum Rn (T) axial lines	Sum Rn (P) axial lines	Strat. value
Abchuchyard	•	1	•	1	•	1.48	•	1.48	•	1.27	•	1.27
Bank Corner	1	1	•	2	5.51	3.43	•	8.93	1.55	1.40	•	2.95
Exchange Sq.	4	1	1	6	13.30	3.36	2.61	19.27	4.78	1.15	1.16	7.09
Fenchurch Pl.	•	1	1	2	•	2.72	3.21	5.93	•	1.17	1.26	2.43
Finsbury Av.	5	•	•	5	15.59	•	•	15.59	6.02	•	•	6.02
Fleet Place	•	1	2	3	•	3.60	6.79	10.39	•	1.39	2.69	4.08
Love Lane	1	1	•	2	2.72	3.52	•	6.24	1.19	1.32	•	2.51
New Change	•	2	•	2	•	7.82	•	7.82	•	2.72	•	2.72
N. Guildhall	1	1	•	2	2.84	2.72	•	5.55	1.25	1.19	•	2.44
Royal Exch.	1	2	•	3	3.46	7.46	•	10.91	1.37	2.77	•	4.13
St Anne	1	1	•	2	4.57	2.87	•	7.44	1.41	1.27	•	2.68
Whittington	•	•	1	1	•	•	3.94	3.94	•	•	1.39	1.39

Names	Rn value main line	Rn value effective space	Mean Rn value "London"	Rn value es. R	Total n° intersecti on points	2 axial lines/ point	3 axial lines/ point
Abchuchyard	1.2742	1.1302	1.0328	1.0937	•	•	•
Bank Corner	1.5526	1.3441	1.0328	1.3006	1	1	•
Exchange Sq.	1.2425	1.1166	1.0328	1.0805	7	6	1
Fenchurch Place	1.2638	1.1225	1.0328	1.0862	1	1	•
Finsbury Av.	1.2796	1.1381	1.0328	1.1013	4	2	2
Fleet Place	1.3880	1.2583	1.0328	1.2176	•	•	•
Love Lane	1.3223	1.1691	1.0328	1.1313	1	1	•
New Change	1.4077	1.2344	1.0328	1.1945	1	1	•
North Guildhall	1.2532	1.1173	1.0328	1.0812	1	1	•
Royal Exch.	1.3967	1.2266	1.0328	1.1870	1	•	1
St Anne St Agnes	1.4077	1.2342	1.0328	1.1943	1	1	•
Whittington Gds.	1.3869	1.2179	1.0328	1.1786	•	•	•

Table 4.5. City of London public spaces correlation matrix – convex container representation (1/2)

Variable	Convex container area (m2)	Isovist area (m2)	Visibility ratio	Enclosure ratio	Sum isov. length total	Mean sum isov. length total	Sum isov. length select	Mean sum isov. length select
Convex container area (m2)	1.000							
Isovist area (m2)	-.5970	1.000						
Visibility ratio	-.9980	.6468	1.000					
Enclosure ratio	-.9837	.4432	.9703	1.000				
Sum isovist length (total)	-.5632	.9991	.6146	.4056	1.000			
Mean sum isovist length (total)	-.7143	.9879	.7574	.5769	.9806	1.000		
Sum isovist length (selected)	-.7532	.9774	.7935	.6228	.9677	.9984	1.000	
Mean sum isovist length (selec.)	-.6364	.9987	.6842	.4875	.9958	.9944	.9867	1.000
Sum isovist length (special)	-.7524	.9776	.7928	.6218	.9681	.9984	1.000	.9869
Mean sum isovist length (special)	-.6227	.9995	.6713	.4720	.9973	.9924	.9837	.9998
Sum axial lines length	-.7392	.9816	.7806	.6062	.9728	.9993	.9998	.9899
Mean sum axial lines length	-.8901	.8970	.9173	.7938	.8779	.9547	.9702	.9180
Nº axial lines (C)	.9911	-.4849	-.9806	-.9989	-.4482	-.6147	-.6589	-.5281
Nº axial lines (T)	.0565	.7672	.0071	-.2350	.7931	.6583	.6141	.7341
Nº axial lines (P)	-.8929	.1719	.8625	.9593	.1309	.3227	.3764	.2210
Sum nº axial lines	.8929	-.1719	-.8625	-.9593	-.1309	-.3227	-.3764	-.2210
Sum R3 value (C)	.8398	-.0659	-.8036	-.9237	-.0244	-.2199	-.2755	-.1158
Sum R3 value (T)	.0749	.7553	-.0113	-.2528	.7818	.6444	.5995	.7215
Sum R3 value (P)	-.9682	.3774	.9504	.9974	.3387	.5166	.5648	.4233
Local strategic value	-.3507	.9606	.4095	.1767	.9713	.9059	.8801	.9455
Sum Rn value (C)	.9083	-.2068	-.8799	-.9687	-.1660	-.3561	-.4091	-.2555
Sum Rn value (T)	-.0575	.8352	.1209	-.1228	.8574	.7398	.7000	.8067
Sum Rn value (P)	-.9311	.2633	.9060	.9815	.2230	.4098	.4614	.3112
Strategic value	-.1988	.9049	.2607	.0194	.9218	.8279	.7943	.8824
Rn value main line	-.8427	.9350	.8752	.7322	.9195	.9787	.9889	.9516
Nº intersection points	.5482	.3437	-.4939	-.6895	.3824	.1938	.1372	.2963

Variable	Sum isovist length special	Mean sum isovist length special	Sum axial lines length	Mean sum axial line length	Nº axial lines (C)	Nº axial lines (T)	Nº axial lines (P)	Sum nº axial lines
Convex container area (m2)								
Isovist area (m2)								
Visibility ratio								
Enclosure ratio								
Sum isovist length (total)								
Mean sum isovist length (total)								
Sum isovist length (selected)								
Mean sum isovist length (selec.)								
Sum isovist length (special)	1.000							
Mean sum isovist length (special)	.9839	1.000						
Sum axial lines length	.9998	.9873	1.000					
Mean sum axial lines length	.9699	.9109	.9649	1.000				
Nº axial lines (C)	-.6580	-.5130	-.6429	-.8215	1.000			
Nº axial lines (T)	.6151	.7460	.6306	.4046	.1890	1.000		
Nº axial lines (P)	.3753	.2038	.3568	.5896	-.9449	-.5000	1.000	
Sum nº axial lines	-.3753	-.2038	-.3568	-.5896	.9449	.5000	-1.000	1.000
Sum R3 value (C)	-.2743	-.0982	-.2552	-.5002	.9046	.5895	-.9943	.9943
Sum R3 value (T)	.6005	.7336	.6162	.3878	.2070	.9998	-.5158	.5158
Sum R3 value (P)	.5638	.4073	.5473	.7479	-.9929	-.3044	.9771	-.9771
Local strategic value	.8807	.9511	.8899	.7389	-.2228	.9152	-.1085	.1085
Sum Rn value (C)	-.4080	-.2384	-.3898	-.6180	.9559	.4689	-.9994	.9994
Sum Rn value (T)	.7009	.8170	.7149	.5062	.0759	.9935	-.3981	.3981
Sum Rn value (P)	.4603	.2944	.4426	.6626	-.9714	-.4168	.9956	-.9956
Strategic value	.7951	.8906	.8070	.6235	-.0665	.9672	-.2638	.2638
Rn value main line	.9887	.9461	.9855	.9954	-.7635	.4899	.5100	-.5100
Nº intersection points	.1385	.3130	.1581	-.1068	.6547	.8660	-.8660	.8660

Table 4.5. City of London public spaces correlation matrix – convex container representation (2/2)

Variable	Sum R3 value (C)	Sum R3 value (T)	Sum R3 value (P)	Local strategic value
Convex container area (m2)				
Isovist area (m2)				
Visibility ratio				
Enclosure ratio				
Sum isovist length (total)				
Mean sum isovist length (total)				
Sum isovist length (selected)				
Mean sum isovist length (selected)				
Sum isovist length (special)				
Mean sum isovist length (special)				
Sum axial lines length				
Mean sum axial lines length				
N° axial lines (C)				
N° axial lines (T)				
N° axial lines (P)				
Sum n° axial lines				
Sum R3 value (C)	1.0000			
Sum R3 value (T)	.6042	1.0000		
Sum R3 value (P)	-.9489	-.3219	1.0000	
Local strategic value	.2139	.9076	.1053	1.0000
Sum Rn value (C)	.9899	.4851	-.9841	.0732
Sum Rn value (T)	.4936	.9912	-.1939	.9551
Sum Rn value (P)	-.9800	-.4335	.9927	-.0151
Strategic value	.3651	.9624	-.0526	.9875
Rn value main line	-.4154	.4738	.6812	.7997
N° intersection points	.9144	.8751	-.7399	.5910

Variable	Sum Rn value (C)	Sum Rn value (T)	Sum Rn value (P)	Strategic value	Rn value main line	N° inter. points
Convex container area (m2)						
Isovist area (m2)						
Visibility ratio						
Enclosure ratio						
Sum isovist length (total)						
Mean sum isovist length (total)						
Sum isovist length (selected)						
Mean sum isovist length (selec.)						
Sum isovist length (special)						
Mean sum isovist length (special)						
Sum axial lines length						
Mean sum axial lines length						
N° axial lines (C)						
N° axial lines (T)						
N° axial lines (P)						
Sum n° axial lines						
Sum R3 value (C)						
Sum R3 value (T)						
Sum R3 value (P)						
Local strategic value						
Sum Rn value (C)	1.0000					
Sum Rn value (T)	.3653	1.0000				
Sum Rn value (P)	-.9983	-.3106	1.0000			
Strategic value	.2293	.9899	-.1724	1.0000		
Rn value main line	-.5402	.5860	.5882	.6952	1.0000	
N° intersection points	.8477	.8034	-.8155	.7107	-.0116	1.0000

Notes: 3 observations were used in this computation
9 cases were omitted due to missing values

Table 4.6. City of London public spaces correlation matrix – effective space representation (1/2)

Variable	Effective space area (m2)	Iso-vist area (m2)	Visibi-lity ratio	Enclo sure ratio	Sum isov. length total	Mean sum isov. length total	Sum isov. length select	Mean sum isov. length select
Effective space area (m2)	1.0000							
Isovist area (m2)	-.3032	1.0000						
Visibility ratio	-.6707	.8921	1.000					
Enclosure ratio	.6363	-.4719	-.7344	1.0000				
Sum isovist length (total)	-.2479	.7634	.6333	-.3148	1.0000			
Mean sum isovist length (total)	-.3809	.7136	.6950	-.5365	.9492	1.0000		
Sum isovist length (selected)	3.4839E-5	.6601	.4994	-.1401	.7755	.7763	1.0000	
Mean sum isovist length (selec.)	-.3634	.9382	.8937	-.6639	.8388	.8709	.7015	1.0000
Sum isovist length (special)	-.1030	.6572	.4937	.0057	.8220	.7573	.9464	.6399
Mean sum isovist length (special)	-.3781	.9841	.9162	-.5835	.7938	.7701	.6052	.9692
Sum axial lines length	.8735	.1747	-.2307	.3246	.0585	-.0739	.2625	.0995
Mean sum axial lines length	-.0734	.7950	.6702	-.5021	.3904	.3351	.1816	.7224
N° axial lines (C)	.9926	-.2618	-.6188	.5582	-.2271	-.3321	.0620	-.3011
N° axial lines (T)	-.1994	.2153	.1795	.2486	.5147	.4786	.7105	.1997
Sum n° axial lines	.9609	-.2120	-.5850	.6323	-.1003	-.2165	.2443	-.2560
Sum R3 value (C)	.9446	-.0402	-.4254	.3873	-.0239	-.1301	.1830	-.0577
Sum R3 value (T)	-.1644	.2748	.2330	.1995	.4912	.4754	.7783	.2527
Local strategic value	.9015	.0095	-.3864	.4952	.1058	-.0062	.4319	-.0204
Sum Rn value (C)	.9857	-.1826	-.5572	.5194	-.1502	-.2616	.1157	-.2196
Sum Rn value (T)	-.2970	.3152	.3100	.1250	.5615	.5469	.7501	.3053
Strategic value	.9257	-.1027	-.4897	.5936	.0161	-.1031	.3636	-.1452
Rn value main line	-.5646	.9100	.9663	-.7705	.7544	.8172	.5670	.9691
N° intersection points	.9926	-.2618	-.6188	.5582	-.2271	-.3321	.0620	-.3011

Variable	Sum isovist length special	Mean sum isovist length special	Sum axial lines length	Mean sum axial line length	N° axial lines (C)	N° axial lines (T)	Sum n° axial lines
Effective space area (m2)							
Isovist area (m2)							
Visibility ratio							
Enclosure ratio							
Sum isovist length (total)							
Mean sum isovist length (total)							
Sum isovist length (selected)							
Mean sum isovist length (selec.)							
Sum isovist length (special)	1.0000						
Mean sum isovist length (special)	.5950	1.0000					
Sum axial lines length	.1180	.1012	1.0000				
Mean sum axial lines length	.1101	.8111	.3827	1.0000			
N° axial lines (C)	-.0752	-.3357	.8962	-.0411	1.0000		
N° axial lines (T)	.8383	.1456	-.2288	-.4114	-.2000	1.0000	
Sum n° axial lines	.1369	-.3051	.8552	-.1468	.9683	.0510	1.0000
Sum R3 value (C)	.0253	-.0958	.9660	.1842	.9639	-.2369	.9221
Sum R3 value (T)	.8630	.1900	-.1502	-.3474	-.1473	.9834	.1005
Local strategic value	.3074	-.0800	.9032	.0156	.9244	.1152	.9716
Sum Rn value (C)	-.0243	-.2537	.9280	.0299	.9960	-.1944	.9656
Sum Rn value (T)	.8657	.2511	-.2698	-.3223	-.2874	.9899	-.0407
Strategic value	.2583	-.1994	.8648	-.0980	.9390	.1358	.9917
Rn value main line	.5284	.9566	-.1096	.7119	-.5066	.1444	-.4796
N° intersection points	-.0752	-.3357	.8962	-.0411	1.0000	-.2000	.9683

Table 4.6. City of London public spaces correlation matrix – effective space representation (2/2)

Variable	Sum R3 value (C)	Sum R3 value (T)	Local strategic value	Sum Rn value (C)	Sum Rn value (T)	Strategic value	Rn value main line	N° inter. points
Effective space area (m2)								
Isovist area (m2)								
Visibility ratio								
Enclosure ratio								
Sum isovist length (total)								
Mean sum isovist length (total)								
Sum isovist length (select)								
Mean sum isovist length (select)								
Sum isovist length (special)								
Mean sum isovist length (special)								
Sum axial lines length								
Mean sum axial lines length								
N° axial lines (C)								
N° axial lines (T)								
Sum n° axial lines								
Sum R3 value (C)	1.0000							
Sum R3 value (T)	-.1779	1.0000						
Local strategic value	.9348	.1790	1.0000					
Sum Rn value (C)	.9830	-.1400	.9413	1.0000				
Sum Rn value (T)	-.3019	.9853	.0459	-.2759	1.0000			
Strategic value	.9144	.1903	.9909	.9450	.0529	1.0000		
Rn value main line	-.2762	.1893	-.2596	-.4331	.2666	-.3786	1.0000	
N° intersection points	.9639	-.1473	.9244	.9960	-.2874	.9390	-.5066	1.0000

Notes: 6 observations were used in this computation
6 cases were omitted due to missing values
Because of the low number of cases, P axial lines (number and integration values) could not be added in the table

APPENDIX 3

CITY OF LONDON PUBLIC SPACES: LEVELS OF PEDESTRIAN MOVEMENT AND STATIC OCCUPANCY

Plate 5.1. City of London and location of observation gates (1/2)

scale: 1:4000

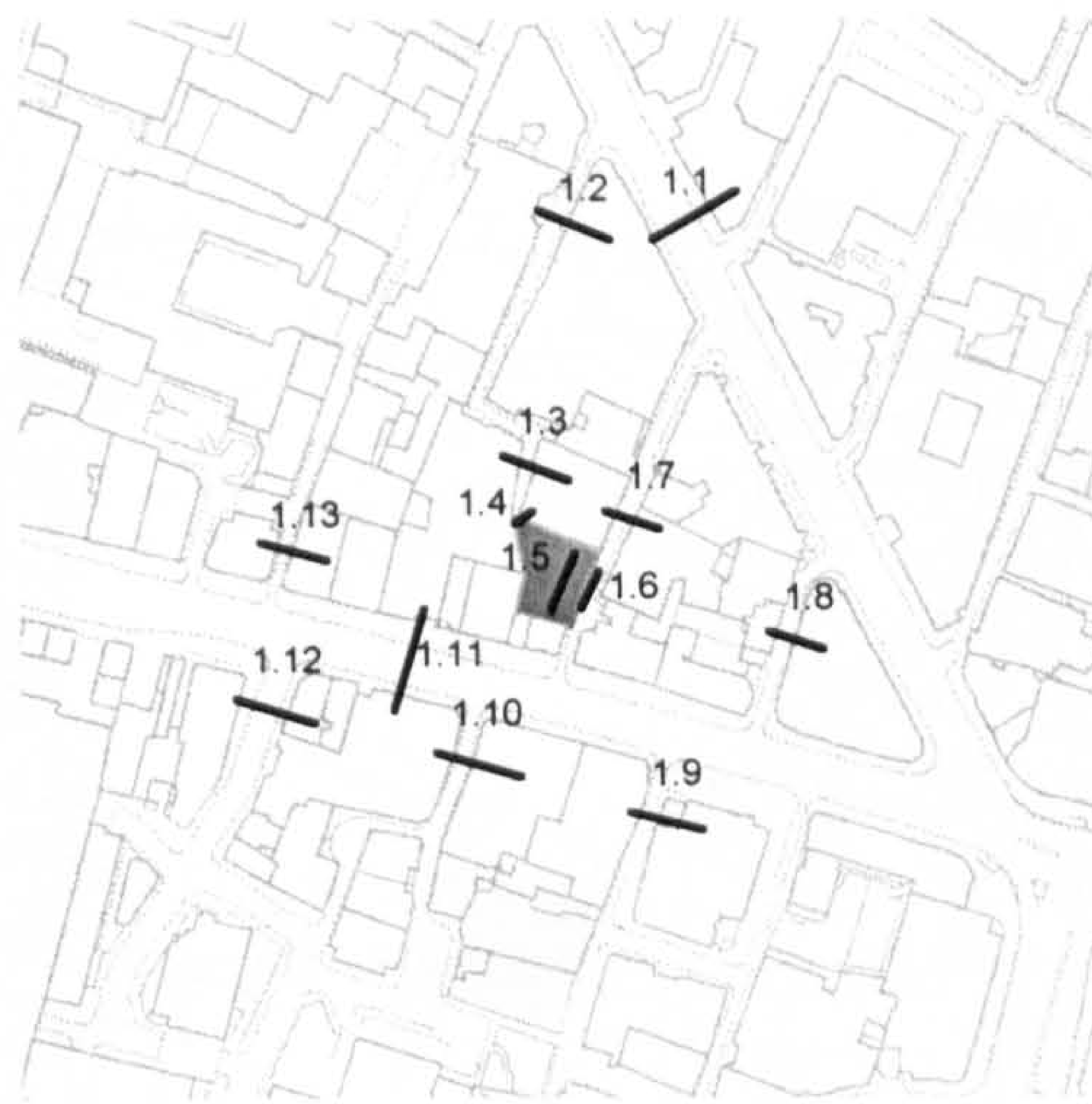


Fig. 1. Abchurchyard

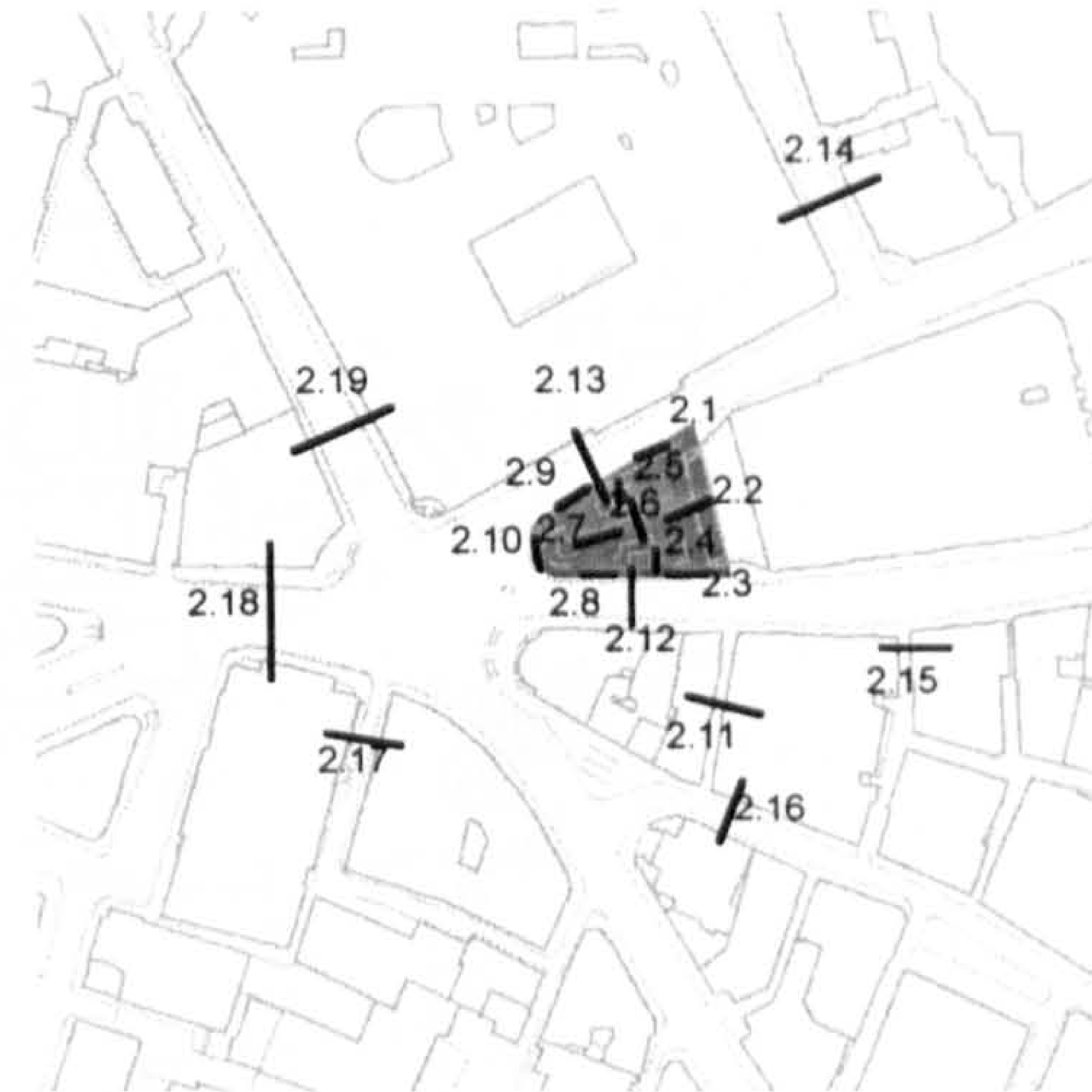


Fig. 2. Bank Corner

Fig. 3. Exchange Square

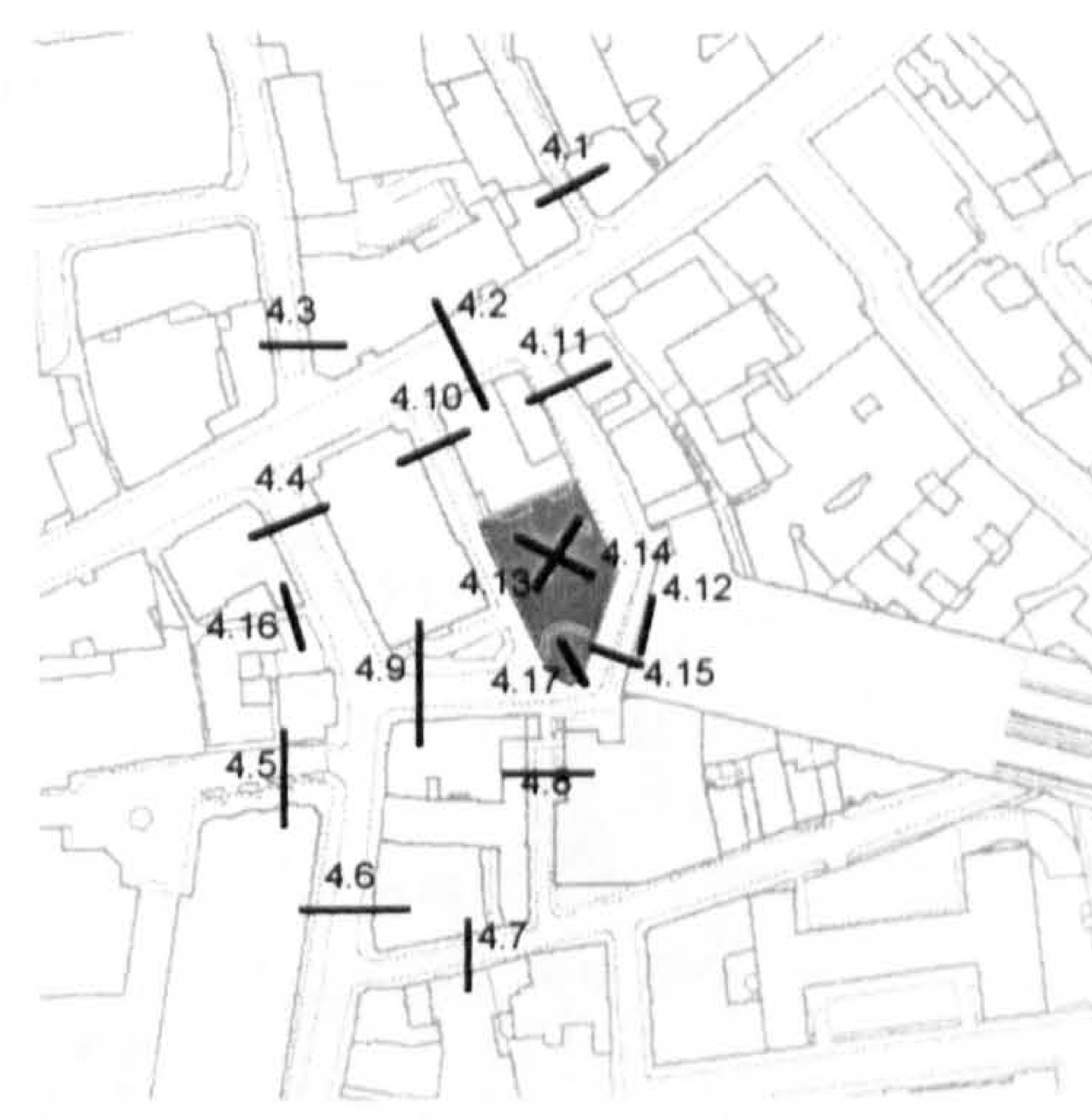


Fig. 4. Fenchurch Place

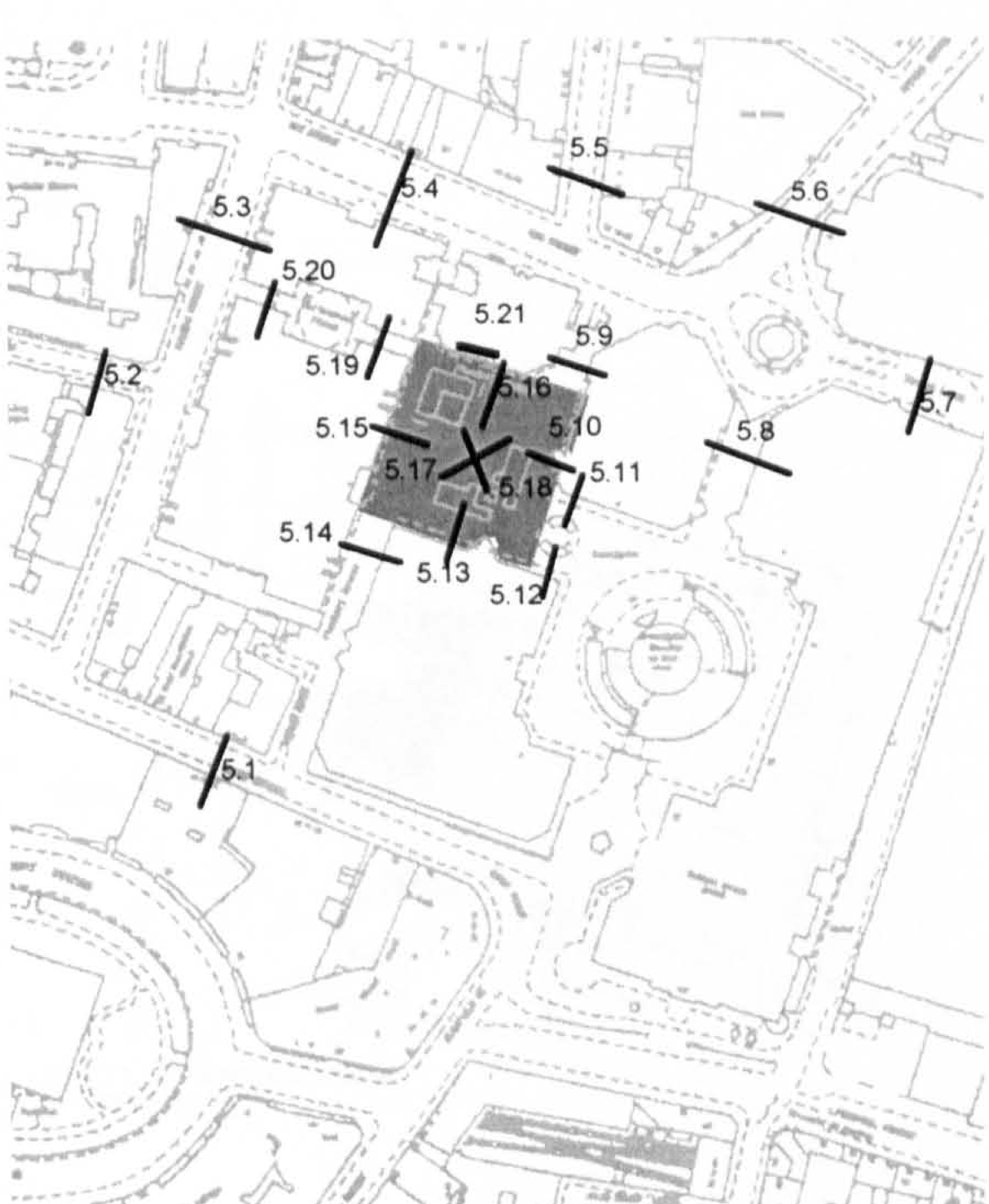


Fig. 5. Finsbury Av.

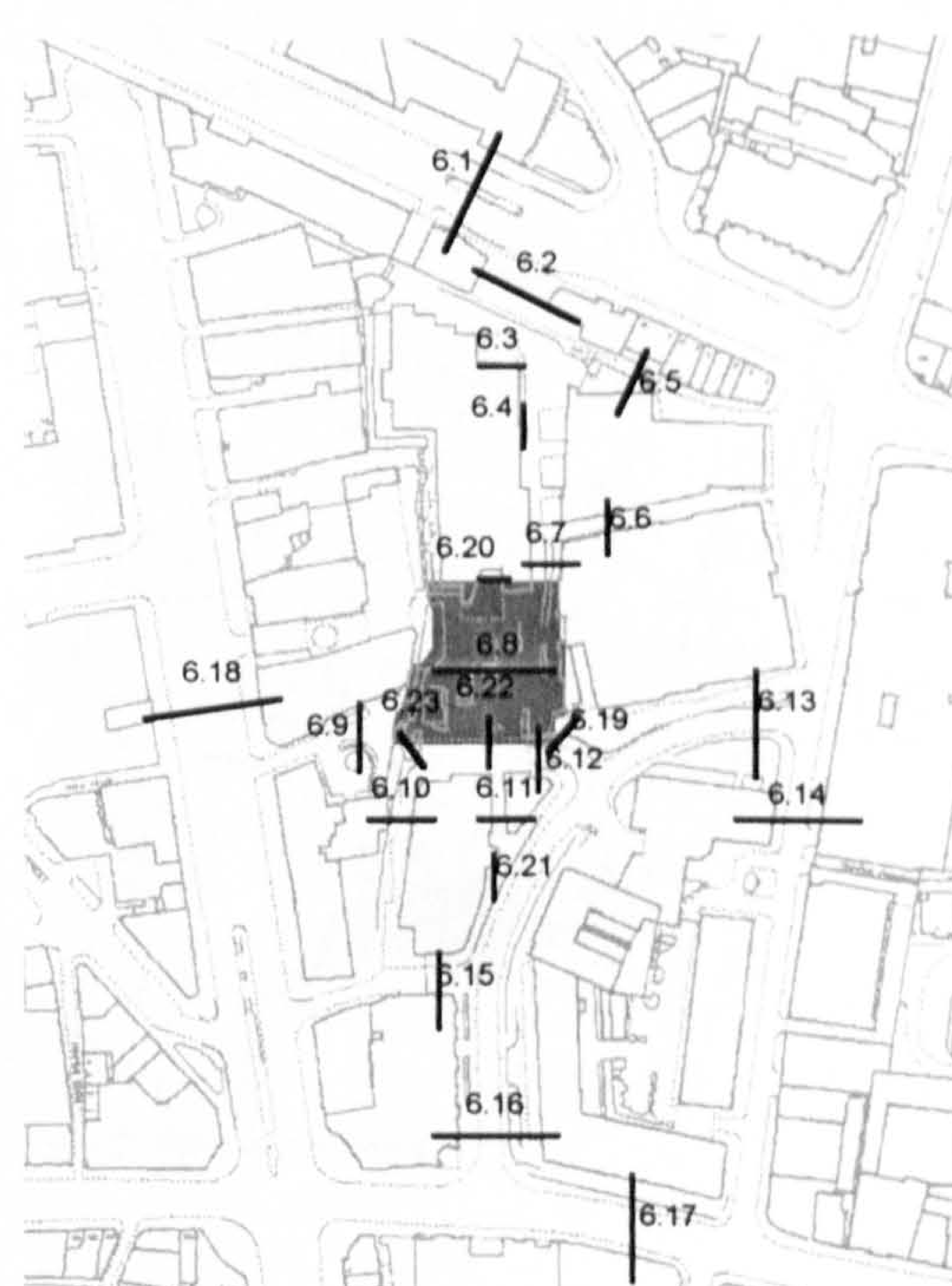


Fig. 6. Fleet Place

Fig. 7. Love Lane Corner

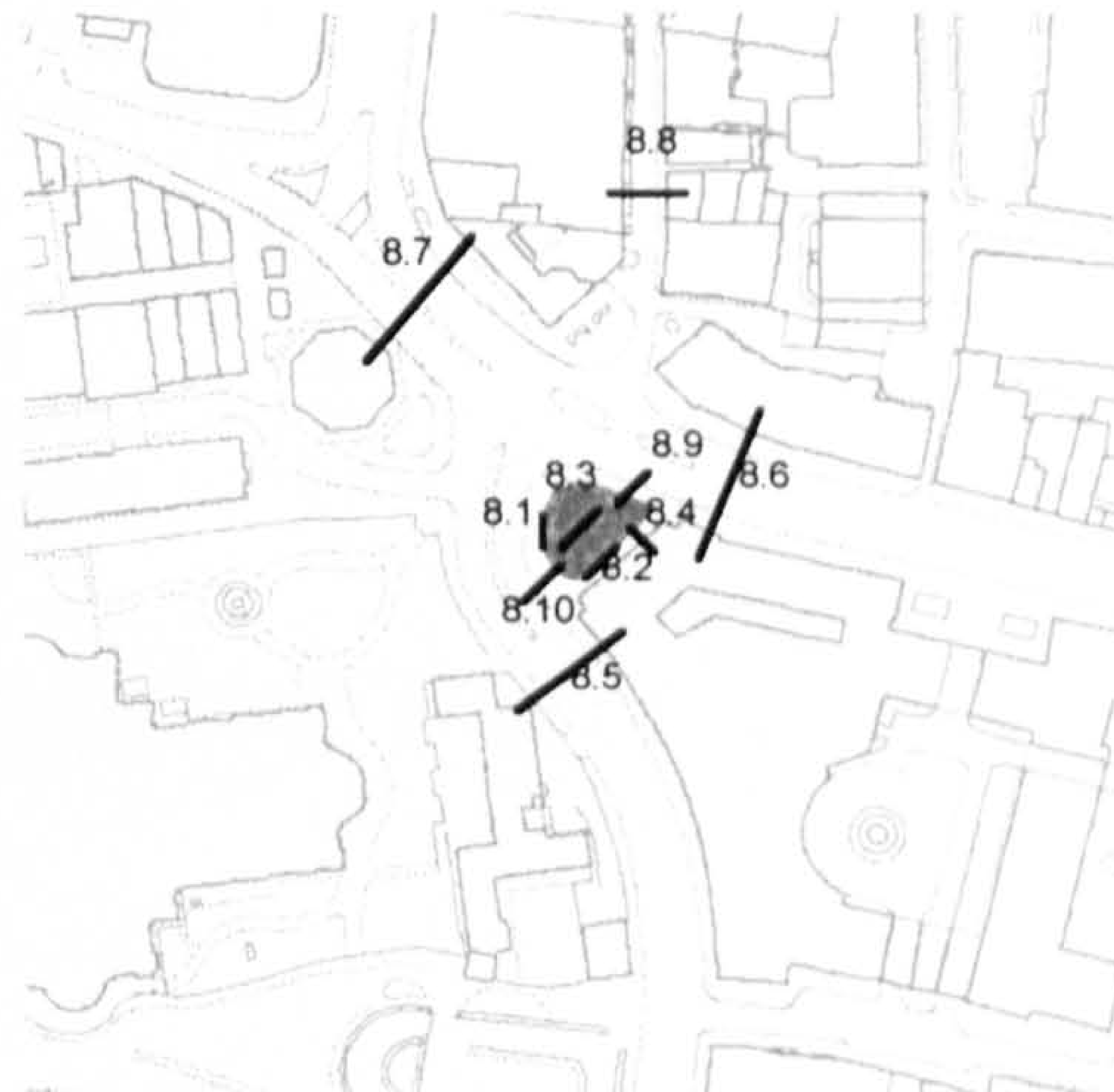


Fig. 8. New Change/Cheapside Corner

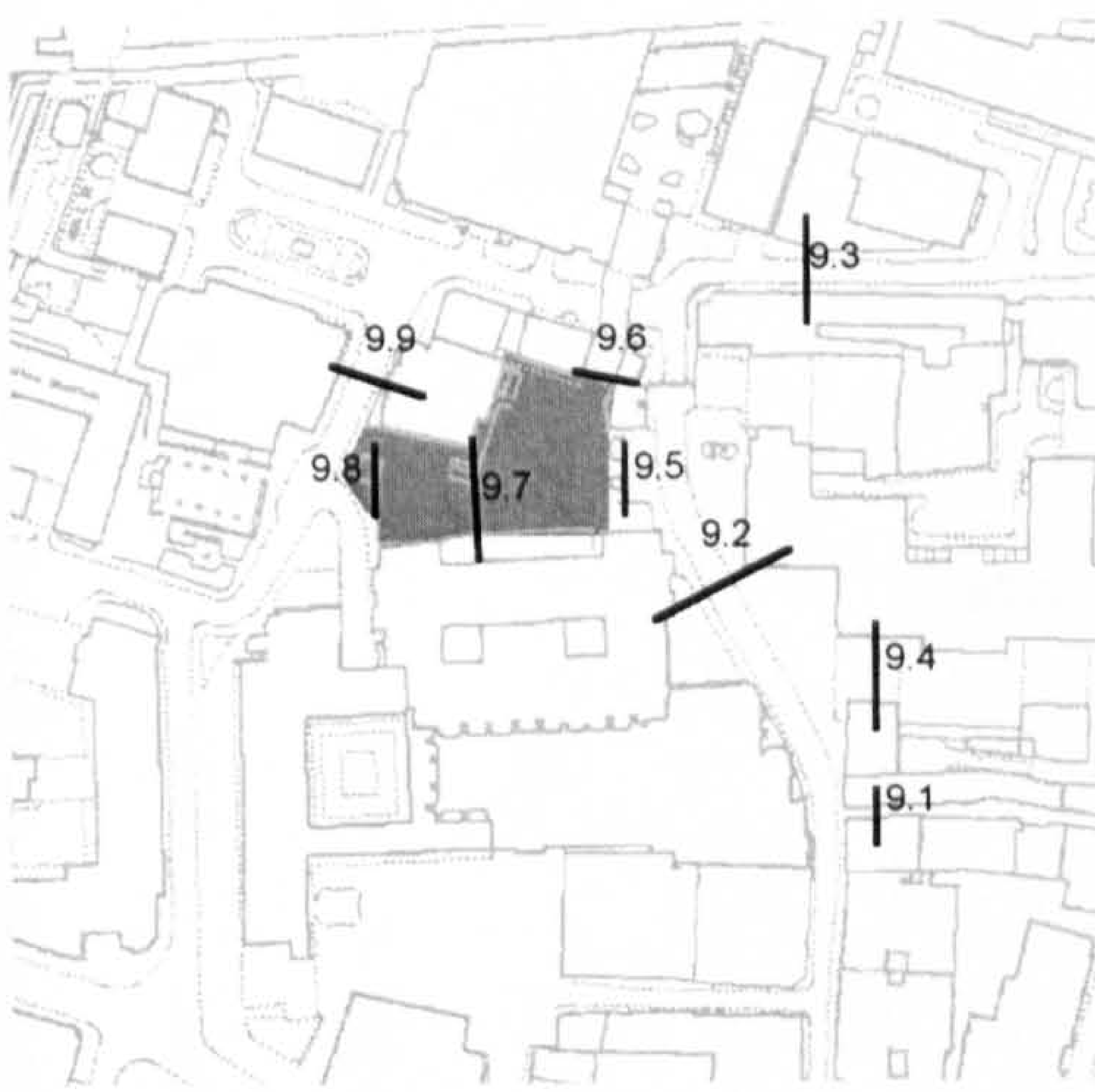


Fig. 9. North Guildhall

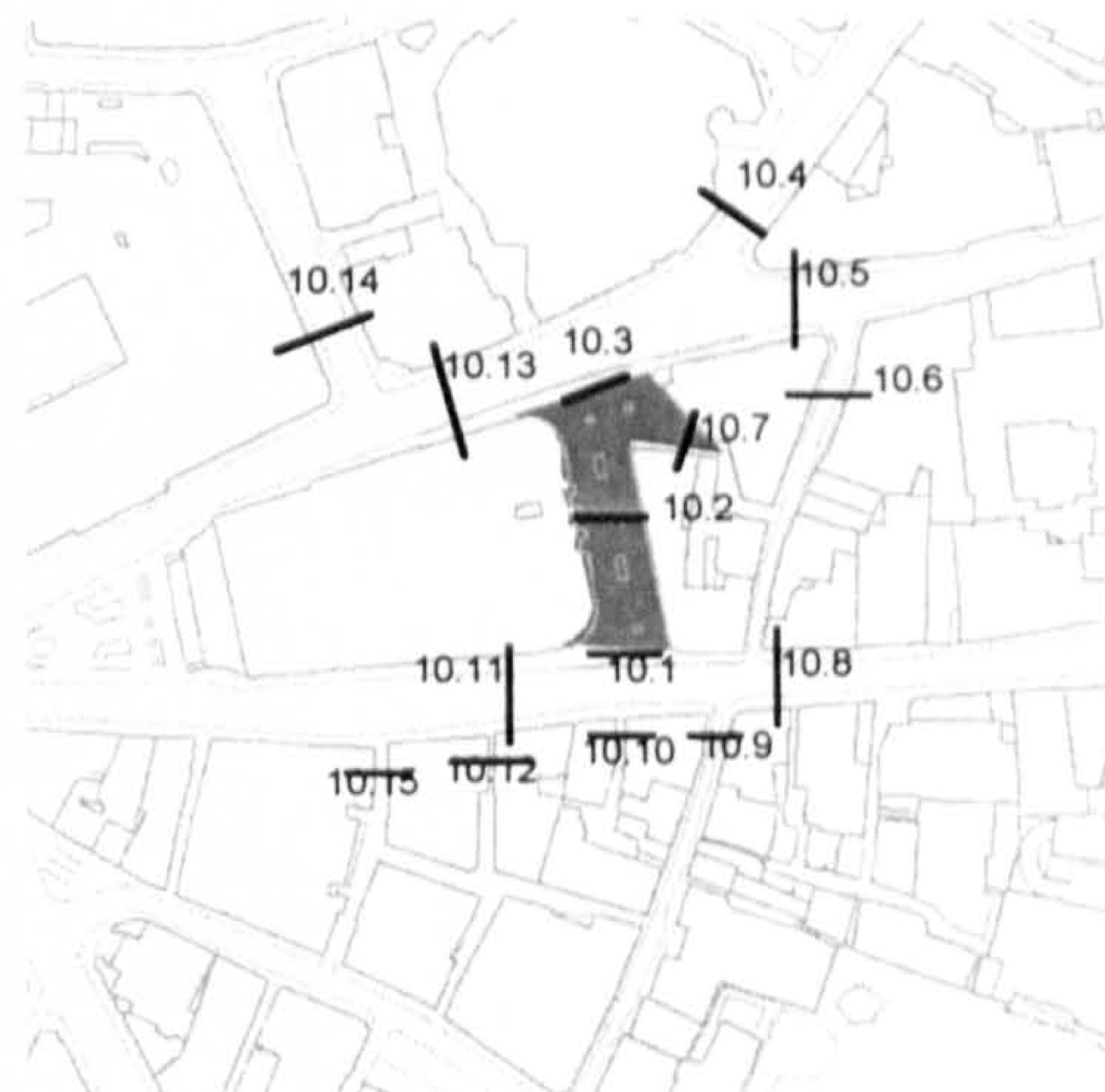


Fig. 10. Royal Exchange

Fig. 11. St. Anne & St. Agnes churchyard

Fig. 12. Whittington Gardens

Plate 5.5. Abchurchyard - Levels of static people distribution throughout the day
Observation: July and August 1996

Time slot	Mean all static	Mean all suits	Mean all suits not at pubs	Mean all suits at pubs
8:00	1	1	1	0
8:10				
8:20	1	1	1	0
8:30	3	2.5	2.5	0
8:40	3	2.5	2.5	0
8:50	3.5	3	3	0
9:00	2	2	2	0
9:10				
9:20	0	0	0	0
9:30				
9:40	2	1	1	0
9:50	2	1	1	0
10:00	1.5	1.5	1.5	0
10:10	2	2	2	0
10:20	0	0	0	0
10:30	1	1	1	0
10:40	4	3	3	0
10:50				
11:00	3.5	2.5	2.5	0
11:10				
11:20	5.5	5.5	5.5	0
11:30	4	4	4	0
11:40	4	4	4	0
11:50	5.5	4.5	4.5	0
12:00	4	4	4	0
12:10	8	8	8	0
12:20				
12:30	10	10	10	0
12:40	14	14	14	0
12:50				
13:00	12	12	12	0
13:10	11	9.5	9.5	0
13:20				
13:30	11	11	10.5	0.5
13:40				
13:50	11.5	11.5	11	0.5
14:00	7	7	7	0
14:10	6.5	5.5	5.5	0
14:20	2.5	2.5	2.5	0
14:30				
14:40	5.5	4	4	0
14:50				
15:00	1	1	1	0
15:10				
15:20	2.5	1.5	1.5	0
15:30	2.5	1.5	1.5	0
15:40	3	1.5	1.5	0
15:50				
16:00	1	1	1	0
16:10				
16:20	1.5	1.5	1.5	0
16:30	0.5	0.5	0.5	0
16:40	1.5	1	1	0
16:50				
17:00	2.5	2.5	2.5	0
17:10				
17:20	1.5	1.5	1.5	0
17:30	0.5	0.5	0.5	0
17:40	2.5	1.5	1.5	0
17:50				
18:00	1	1	1	0
18:10				
18:20	0.5	0.5	0.5	0
18:30	1	1	1	0
18:40	0.5	0.5	0.5	0
18:50				
19:00	0.5	0.5	0.5	0
19:10				
19:20	0	0	0	0
19:30				
19:40	0	0	0	0
19:50				
20:00	0	0	0	0

Table 1. Levels of static people throughout the day

The table gives the mean number of static people over two days
Public space with wine bar/pub

Observations carried out on 5th and 22nd August 1996

Mean temperature:

5th August: 20.6 C, sunny
22nd August: 17.8 C, overcastted with sunny spells

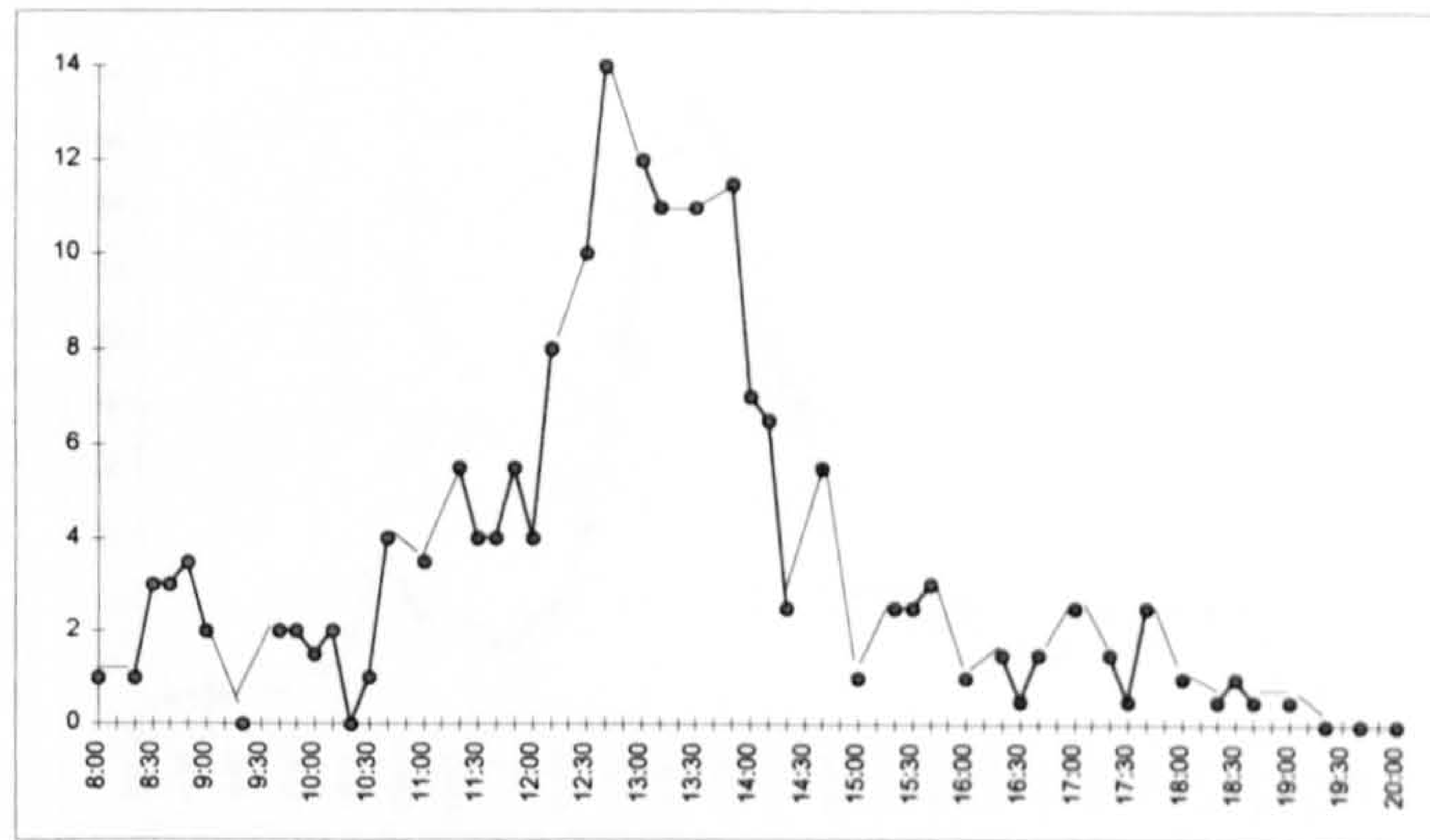


Figure 1. Mean all static

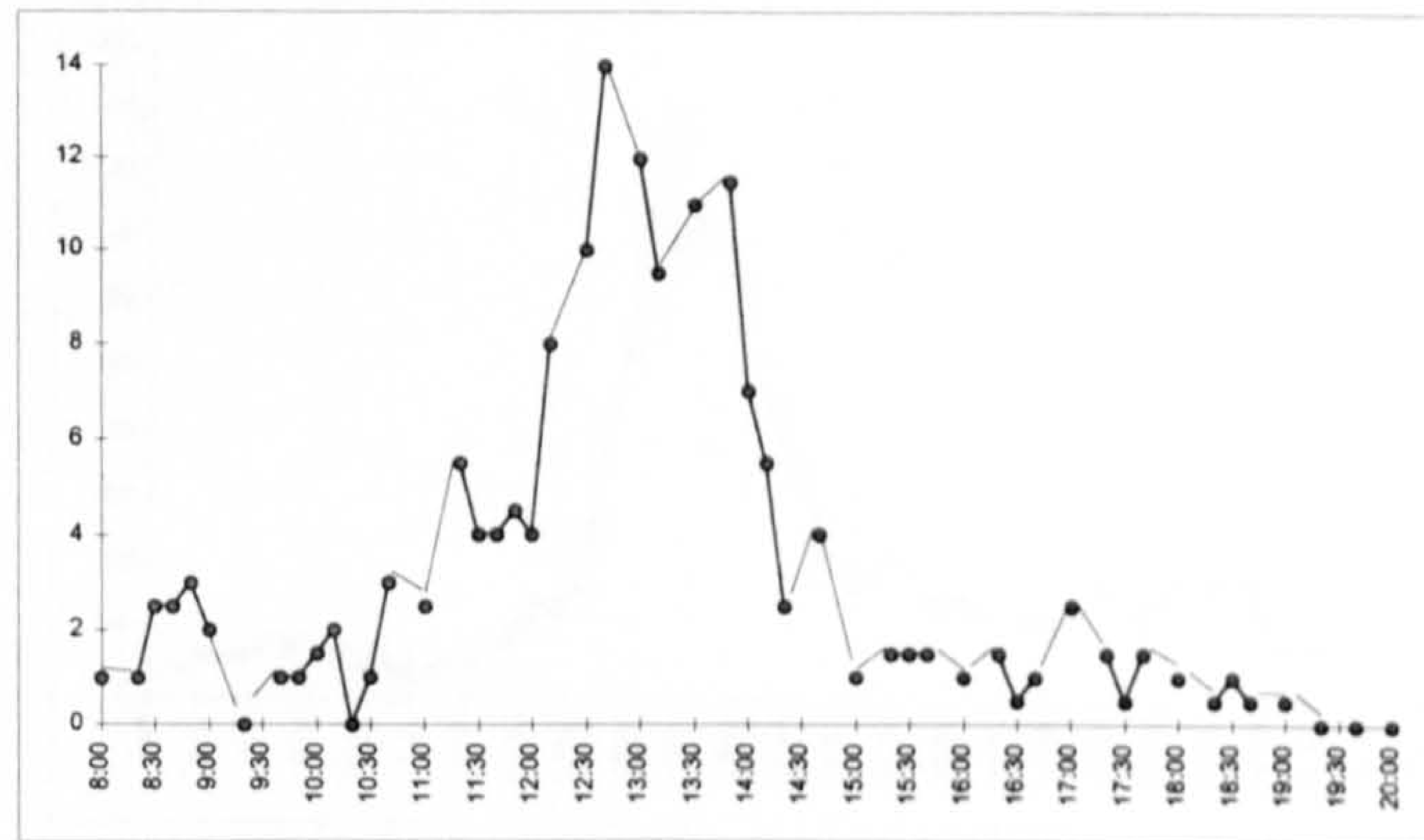


Figure 2. Mean all suits static

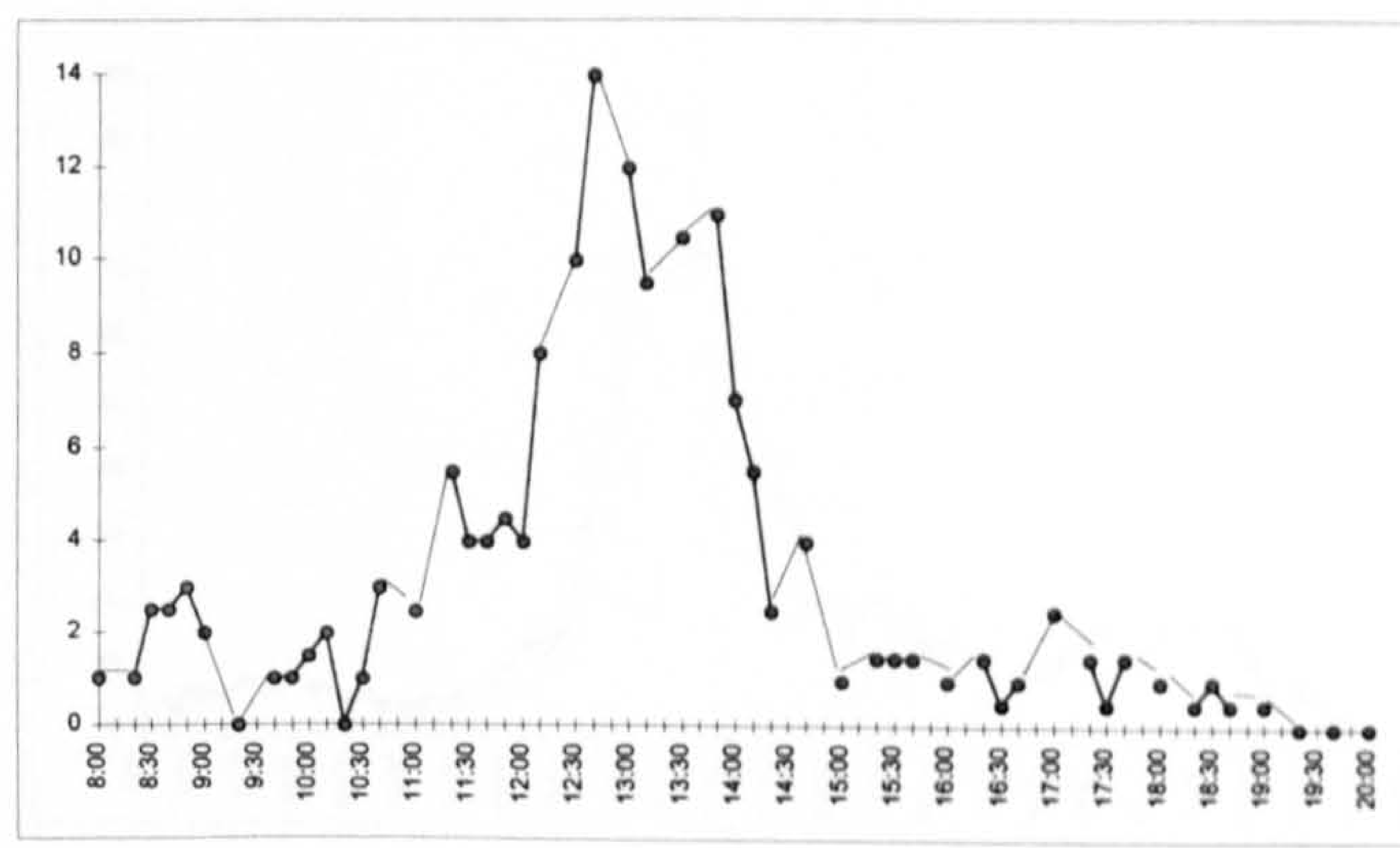


Figure 3. Mean all suits not at pubs static

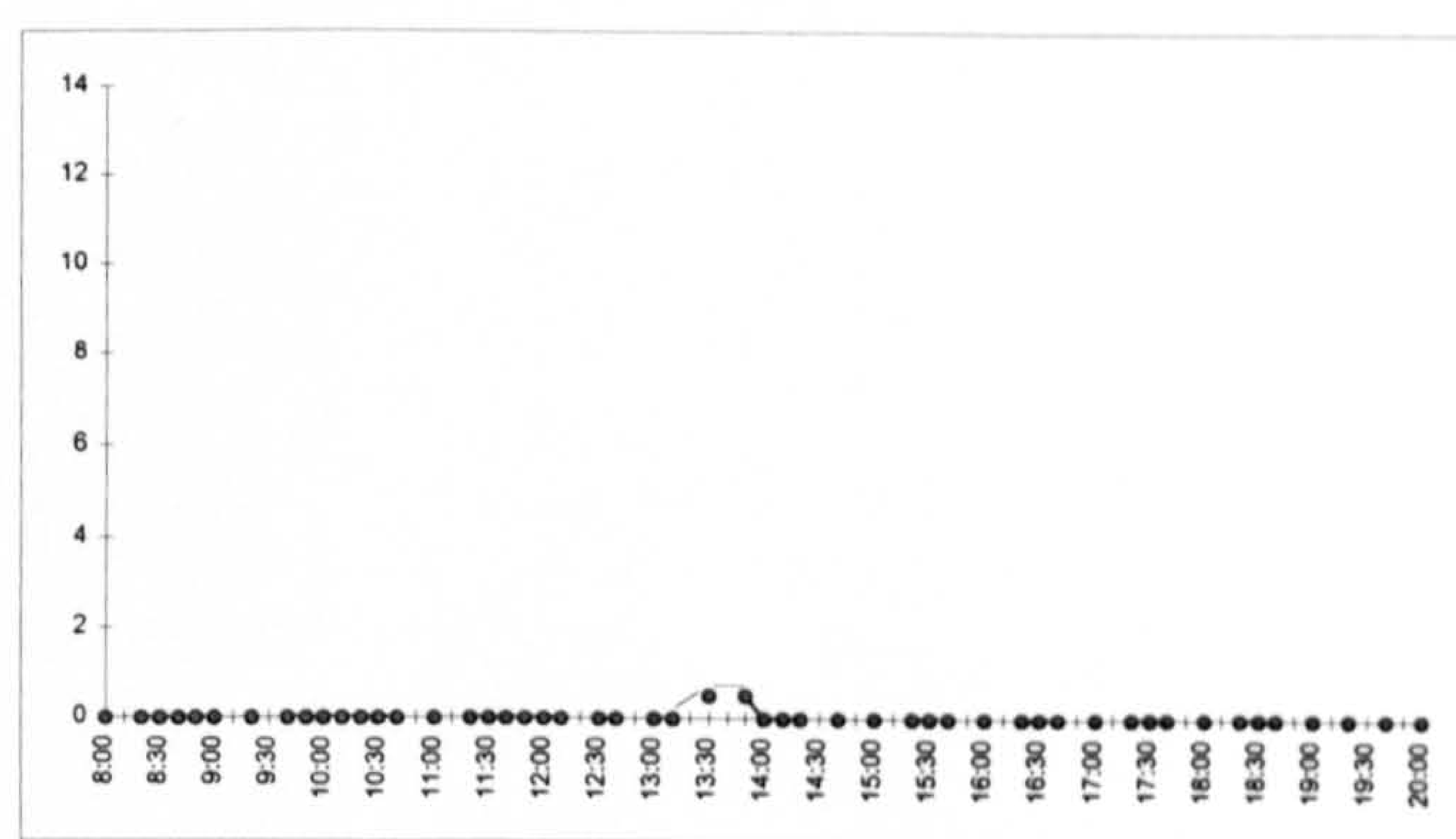


Figure 4. Mean all suits at pubs static

Plate 5.6. Bank Corner - Levels of static people distribution throughout the day
Observation: July and August 1996

Time slot	Mean all static	Mean all suits	Mean all suits not at pubs
8:00	0	0	0
8:10			
8:20	5	4	4
8:30	6	6	6
8:40	7	6	6
8:50	6	6	6
9:00	8	8	8
9:10			
9:20	7	7	7
9:30			
9:40	10.5	7	7
9:50	10.5	7	7
10:00	14.5	4.5	4.5
10:10	24	6.5	6.5
10:20	26.5	4	4
10:30	21	3.5	3.5
10:40	18.5	4.5	4.5
10:50			
11:00	18	5	5
11:10			
11:20	14	8	8
11:30	13.5	11.5	11.5
11:40	17.5	15	15
11:50	20	13.5	13.5
12:00	20.5	16.5	16.5
12:10	32.5	27	27
12:20			
12:30	60	52	52
12:40	86	74.5	74.5
12:50			
13:00	89	70.5	70.5
13:10	96.5	74	74
13:20			
13:30	87	65.5	65.5
13:40			
13:50	60.5	44.5	44.5
14:00	55	37	37
14:10	51.5	33.5	33.5
14:20	34.5	21.5	21.5
14:30			
14:40	23	17	17
14:50			
15:00	23	21.5	21.5
15:10			
15:20	19	15.5	15.5
15:30	18	14.5	14.5
15:40	21.5	15.5	15.5
15:50			
16:00	10.5	7.5	7.5
16:10			
16:20	15	11.5	11.5
16:30	12.5	11.5	11.5
16:40	14	13	13
16:50			
17:00	20	17	17
17:10			
17:20	16	13.5	13.5
17:30	16	15	15
17:40	20.5	17.5	17.5
17:50			
18:00	20	18	18
18:10			
18:20	21	18	18
18:30	16.5	13.5	13.5
18:40	11	8.5	8.5
18:50			
19:00	8.5	8.5	8.5
19:10			
19:20	4.5	4.5	4.5
19:30			
19:40	2.5	2.5	2.5
19:50			
20:00	0	0	0

Table 1. Levels of static people throughout the day

The table gives the mean number of static people over two days
Public space without wine bar/pub

Observations carried out on 17th and 19th July 1996

Mean temperature:

17th July: 16.8 C, sunny
19th July: 19.1 C, sunny

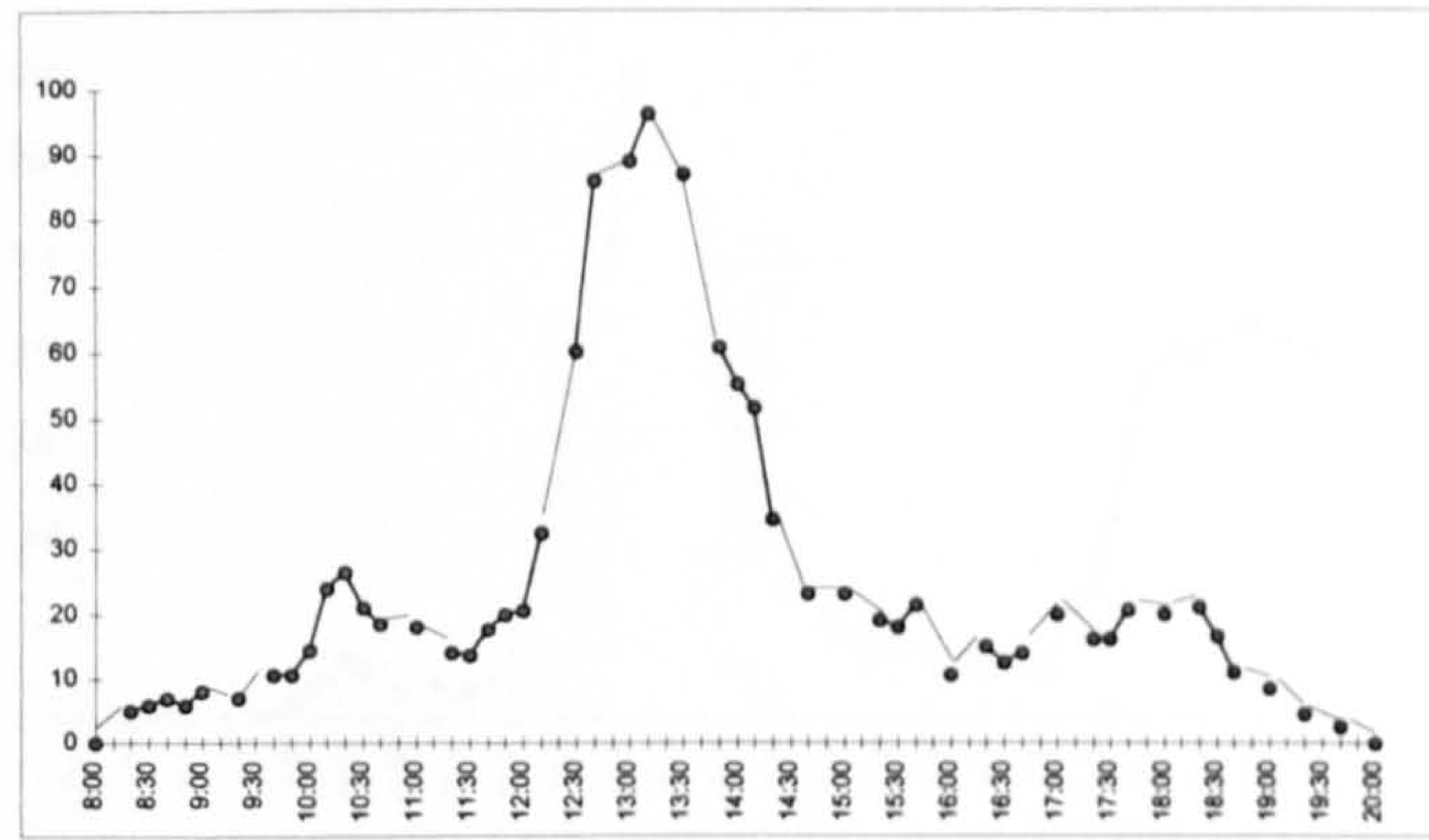


Figure 1. Mean all static

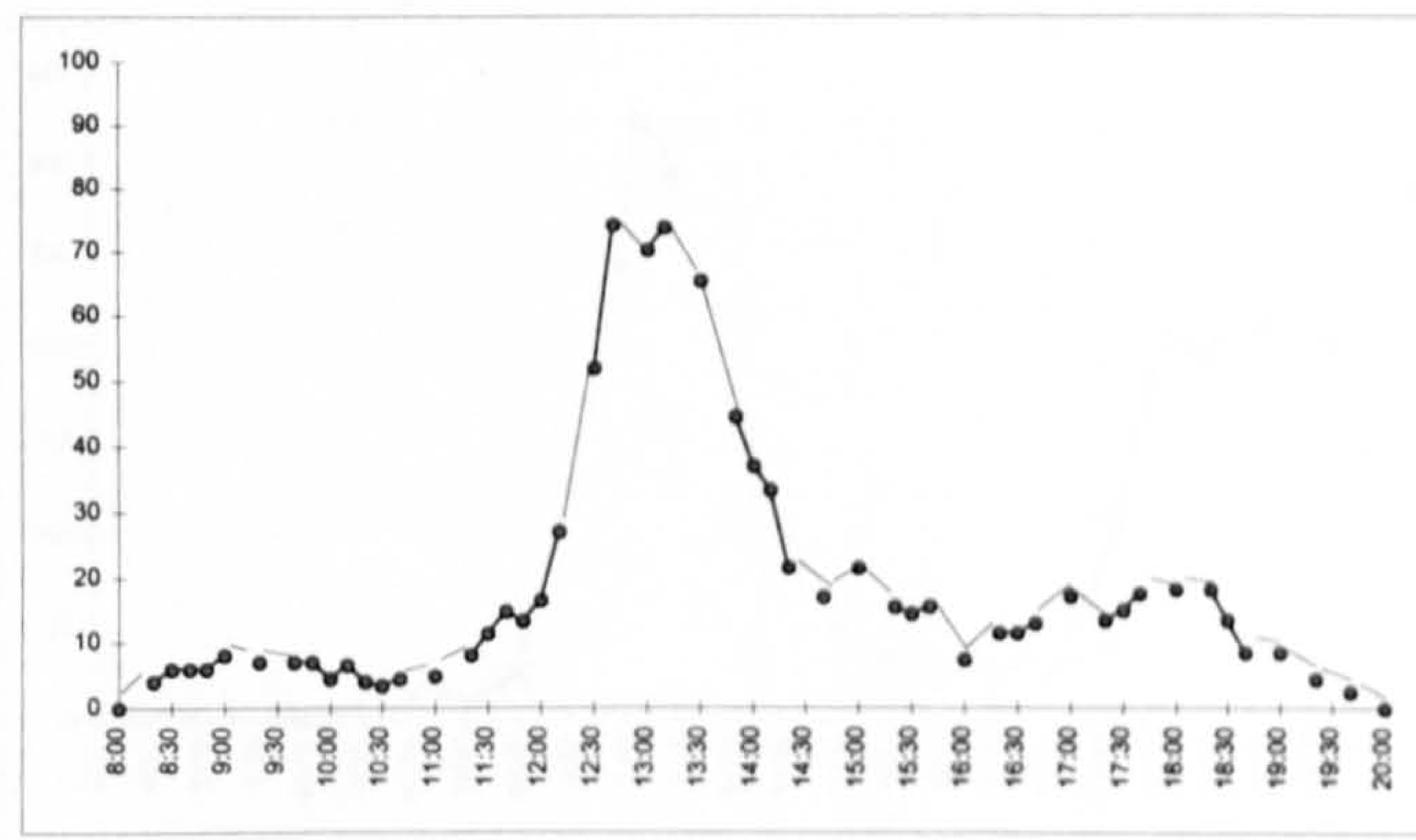


Figure 2. Mean all suits static

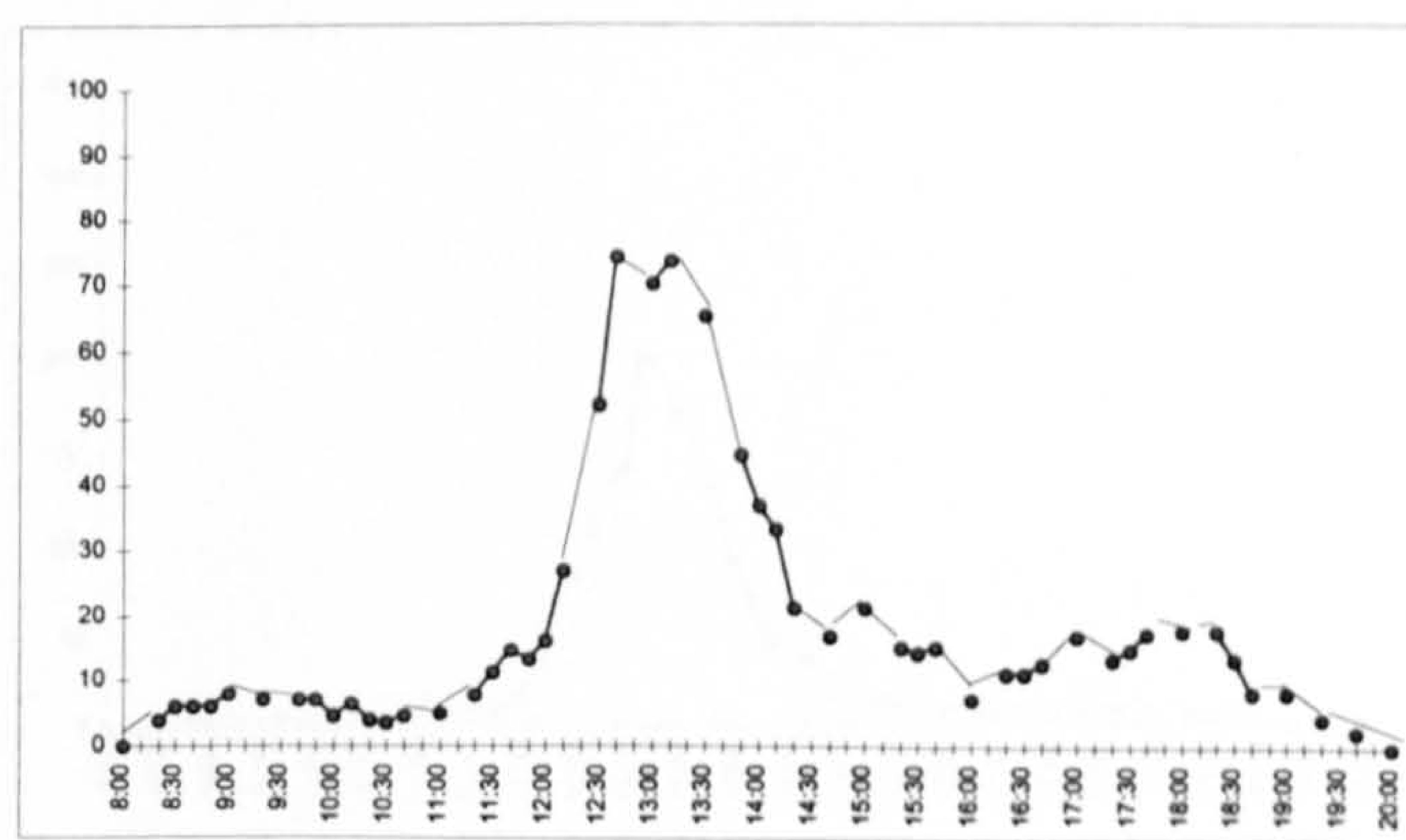


Figure 3. Mean all suits not at pubs static

Plate 5.7. Exchange Square - Levels of static people distribution throughout the day
Observation: July and August 1996

Time slot	Mean all static	Mean all suits	Mean all suits not at pubs	Mean all suits at pubs
8:00	0.5	0.5	0.5	0
8:10				
8:20	1	1	1	0
8:30	3.5	3.5	3.5	0
8:40	6	5.5	5.5	0
8:50	6	4	4	0
9:00	4.5	4.5	4.5	0
9:10				
9:20	3.5	3.5	3.5	0
9:30				
9:40	5.5	5.5	5.5	0
9:50	4	3.5	3.5	0
10:00	9	2	2	0
10:10	17	3.5	1.5	2
10:20	23	4	0.5	3.5
10:30	34.5	8	7	1
10:40	23.5	8	6.5	1.5
10:50				
11:00	15.5	12.5	11.5	1
11:10				
11:20	19.5	13	10	3
11:30	13.5	9	7	2
11:40	16	12	8.5	3.5
11:50	23	19	10.5	8.5
12:00	28	26	17	9
12:10	65.5	61.5	38.5	23
12:20				
12:30	129.5	124.5	82.5	42
12:40	174.5	166	107.5	58.5
12:50				
13:00	256.5	242	139	103
13:10	348	325.5	198.5	127
13:20				
13:30	312	294	168.5	125.5
13:40				
13:50	244.5	232	128	104
14:00	189.5	181.5	90.5	91
14:10	157	149	68.5	80.5
14:20	127	120.5	43	77.5
14:30				
14:40	84	79.5	36	43.5
14:50				
15:00	54	48.5	17.5	31
15:10				
15:20	42	33	12.5	20.5
15:30	37	29.5	12	17.5
15:40	39	31	12.5	18.5
15:50				
16:00	26	22	8	14
16:10				
16:20	33.5	29	8	21
16:30	23	21.5	7.5	14
16:40	29	28	7.5	20.5
16:50				
17:00	22	22	4	18
17:10				
17:20	55	55	6.5	48.5
17:30	79	76	6.5	69.5
17:40	105.5	105.5	8	97.5
17:50				
18:00	182	182	6.5	175.5
18:10				
18:20	200.5	200.5	5.5	195
18:30	189.5	189	3.5	185.5
18:40	201.5	201.5	6.5	195
18:50				
19:00	210	209	1.5	207.5
19:10				
19:20	200	200	0	200
19:30				
19:40	197	197	0	197
19:50				
20:00	141	141	1	140

Table 1. Levels of static people throughout the day

The table gives the mean number of static people over two days
Public space with wine bar/pub

Observations carried out on 30th July and 8th August 1996

Mean temperature:

30th July: 19.5 C, cloudy
8th August: 17.6 C, cloudy

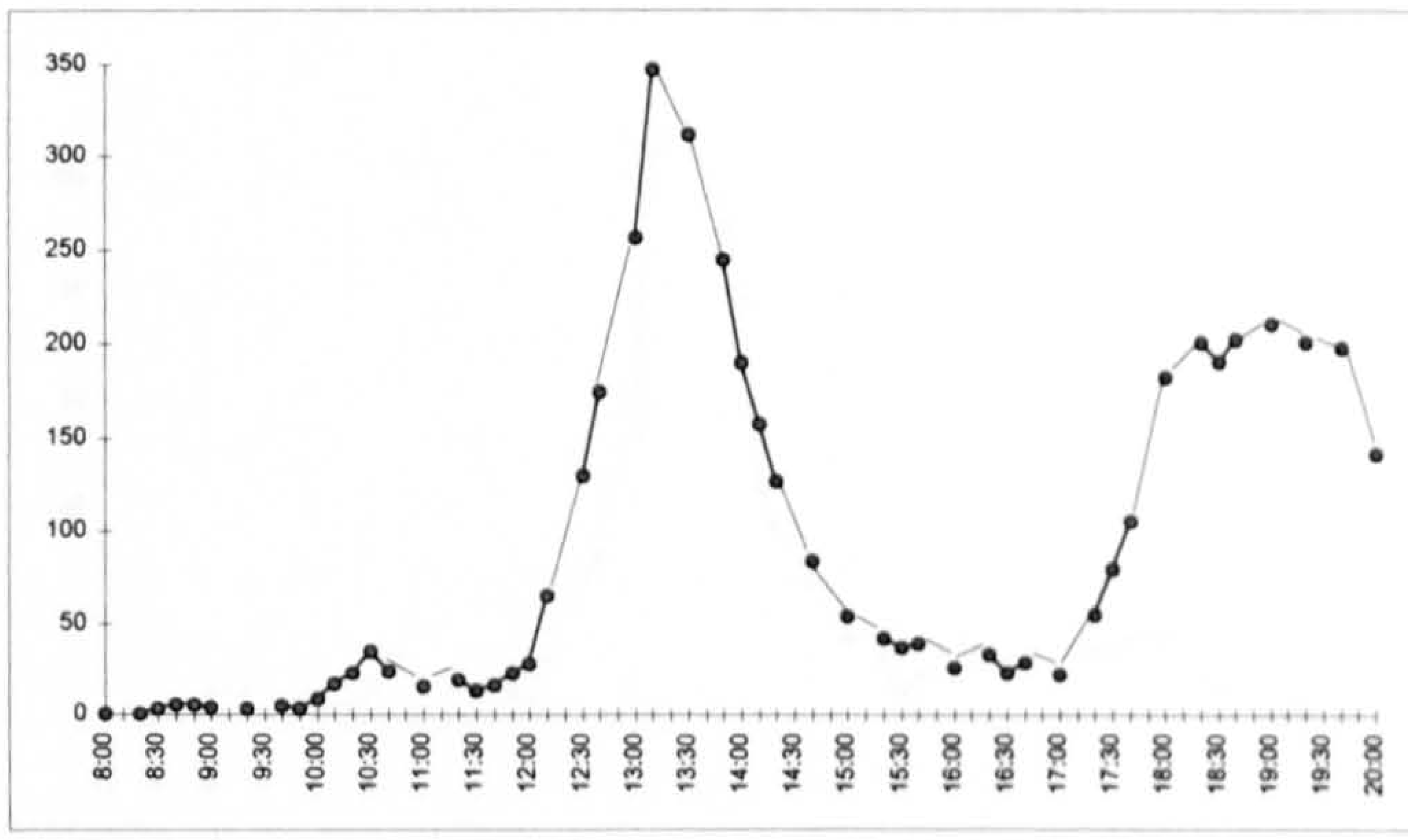


Figure 1. Mean all static

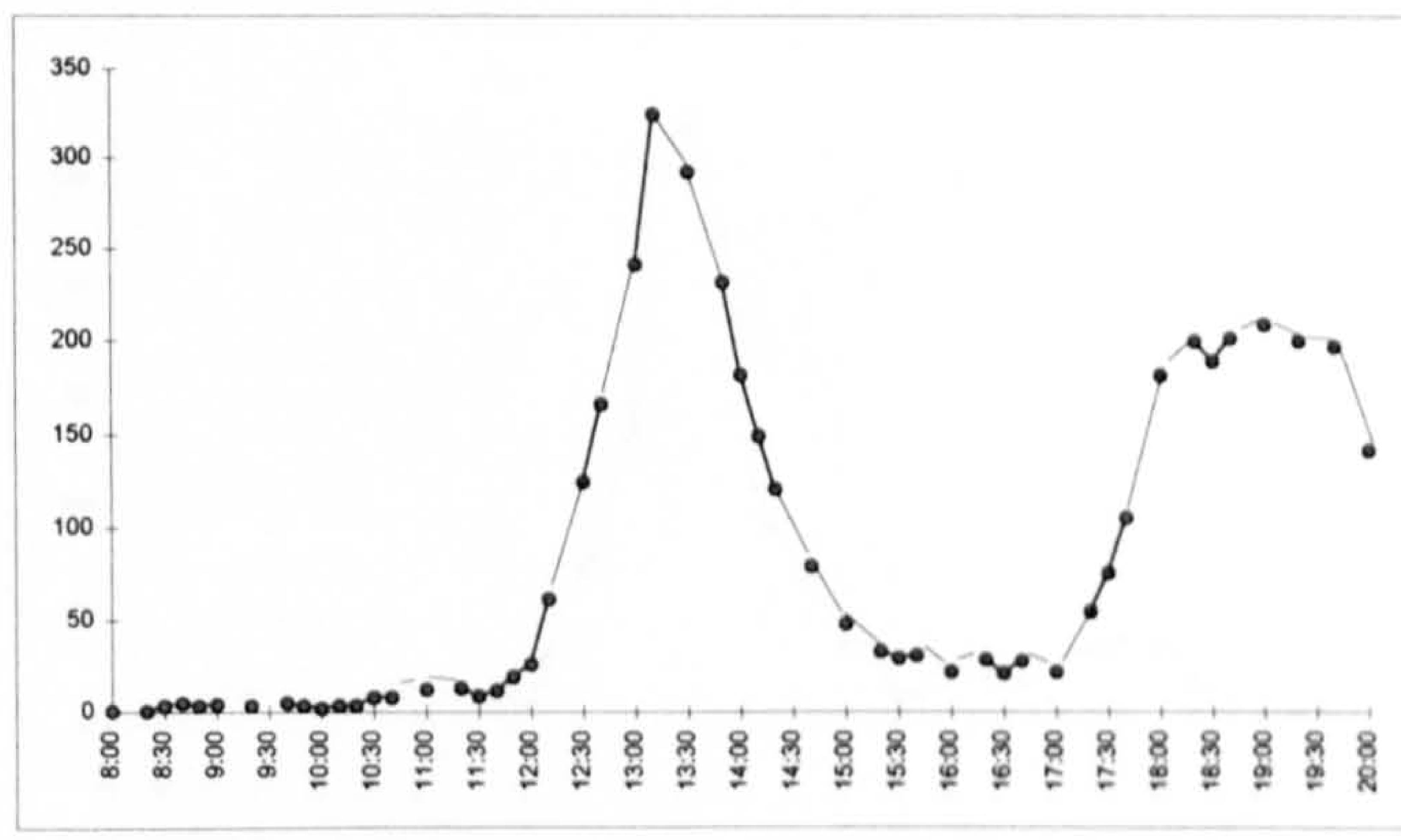


Figure 2. Mean all suits static

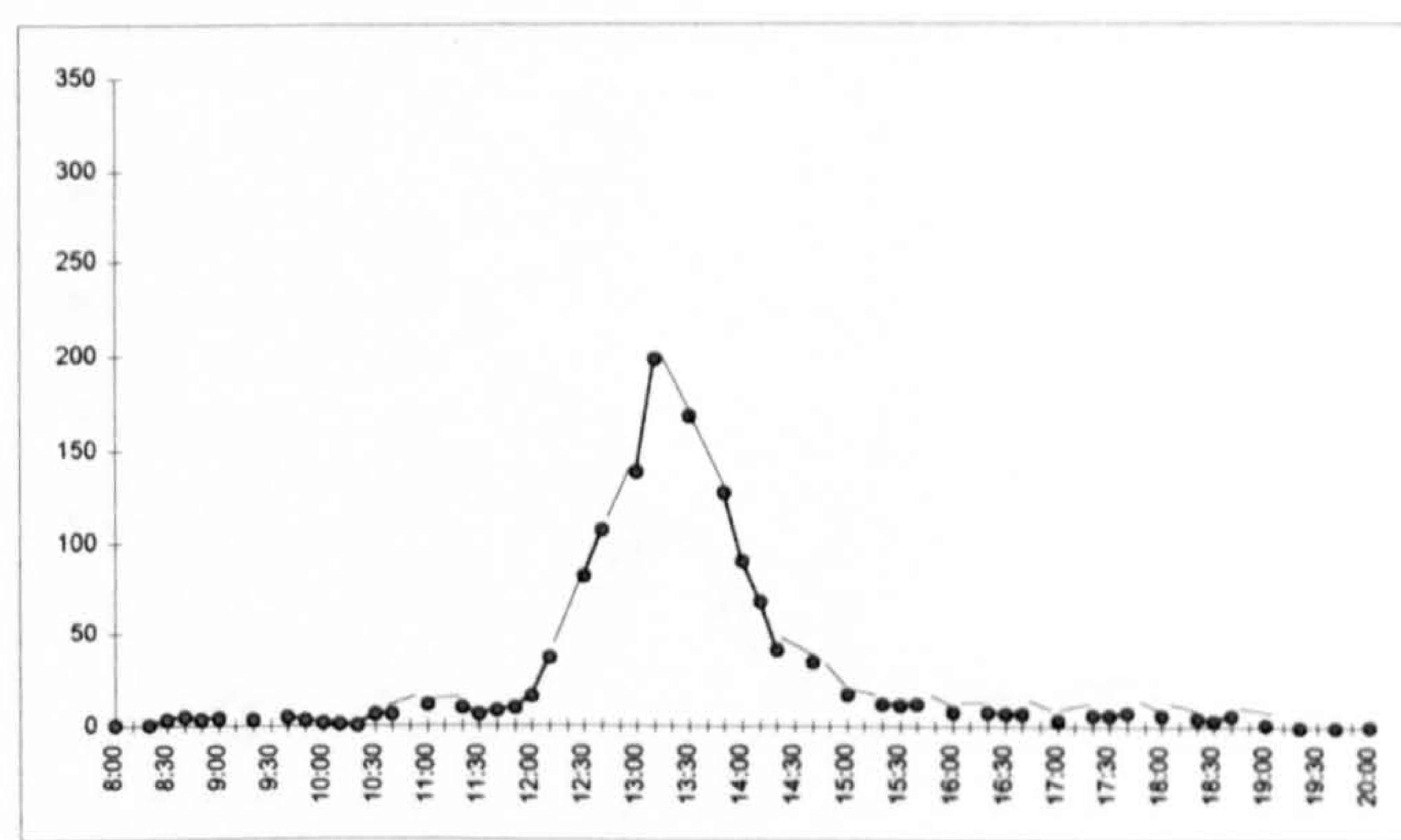


Figure 3. Mean all suits not at pubs static

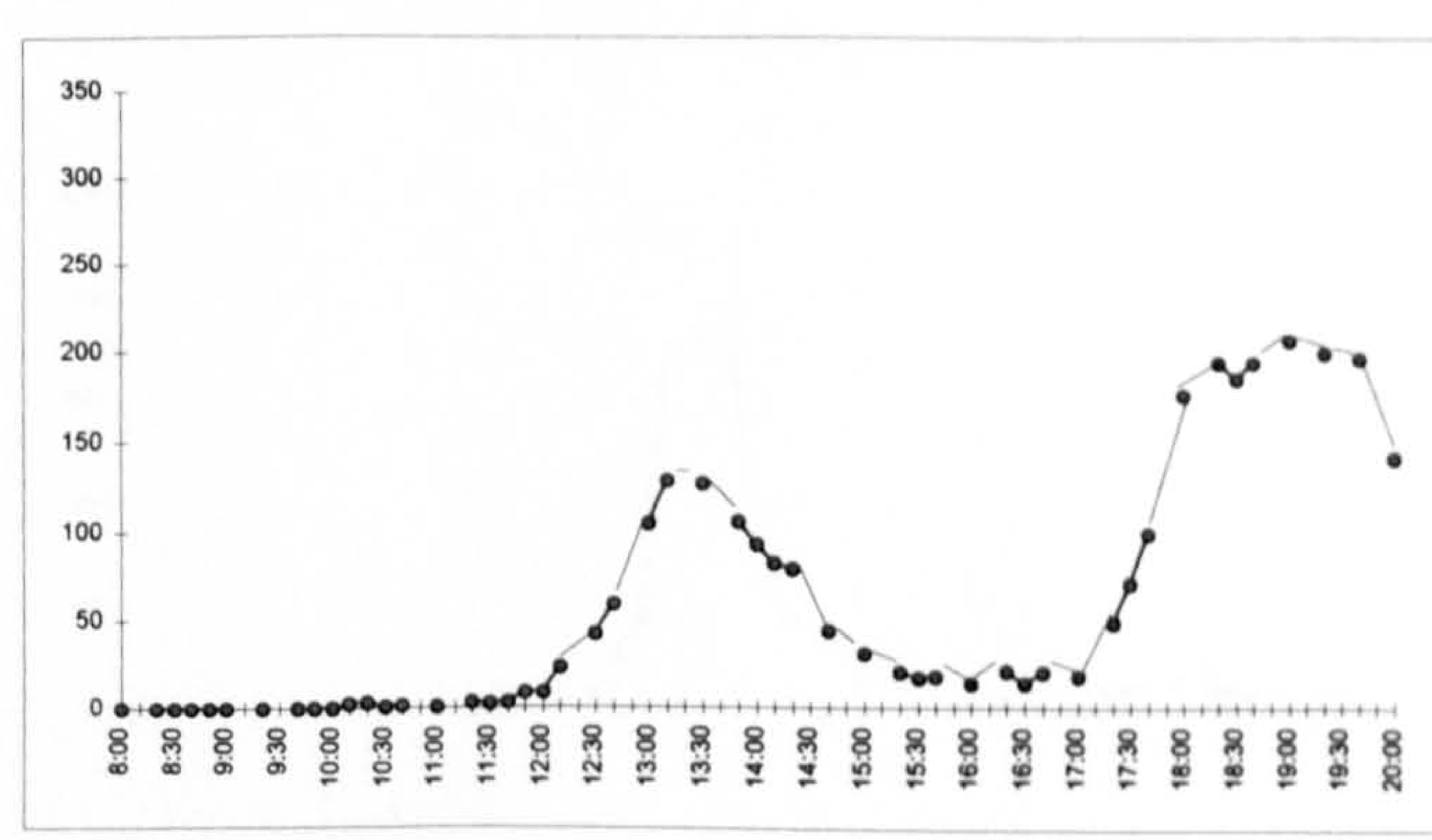


Figure 4. Mean all suits at pubs static

Plate 5.8. Fenchurch Place - Levels of static people distribution throughout the day
Observation: July and August 1996

Time slot	Mean all static	Mean all suits	Mean all suits not at pub	Mean all suits at pubs
8:00	2	2	2	0
8:10				
8:20	2	2	2	0
8:30	1.5	1.5	1.5	0
8:40	2	2	2	0
8:50	4	4	4	0
9:00	4.5	4.5	4.5	0
9:10				
9:20	5.5	5	5	0
9:30				
9:40	4.5	4.5	4.5	0
9:50	4	3	3	0
10:00	2.5	2.5	2.5	0
10:10	3.5	3.5	3.5	0
10:20	3	3	3	0
10:30	7	5	5	0
10:40	12.5	7	7	0
10:50				
11:00	6.5	1	1	0
11:10				
11:20	8.5	5.5	5.5	0
11:30	5	5	5	0
11:40	6	5	5	0
11:50	6.5	6.5	6.5	0
12:00	4	4	4	0
12:10	12.5	12.5	11	1.5
12:20				
12:30	28	28	24.5	3.5
12:40	32	32	27.5	4.5
12:50				
13:00	54	53	35	18
13:10	105	103	40.5	62.5
13:20				
13:30	109.5	109.5	37.5	72
13:40				
13:50	92	90.5	24	66.5
14:00	77	75.5	28.5	47
14:10	43.5	43.5	17	26.5
14:20	36.5	36.5	19	17.5
14:30				
14:40	26.5	26.5	12	14.5
14:50				
15:00	16	15	8.5	6.5
15:10				
15:20	13	12.5	6	6.5
15:30	6	6	1	5
15:40	9	6	1.5	4.5
15:50				
16:00	8.5	8.5	6.5	2
16:10				
16:20	11.5	9.5	7.5	2
16:30	11	9	7.5	1.5
16:40	11	8.5	7	1.5
16:50				
17:00	7.5	5	3.5	1.5
17:10				
17:20	14	14	10.5	3.5
17:30	14.5	14.5	9.5	5
17:40	16	16	11	5
17:50				
18:00	16	14.5	7.5	7
18:10				
18:20	8.5	8.5	3	5.5
18:30	7	7	3	4
18:40	5.5	5	1.5	3.5
18:50				
19:00	1	1	0	1
19:10				
19:20	2.5	2.5	1	1.5
19:30				
19:40	1.5	1.5	0	1.5
19:50				
20:00	0	0	0	0

Table 1. Levels of static people throughout the day

The table gives the mean number of static people over two days
Public space with wine bar/pub

Observations carried out on 31st July and 8th August 1996

Mean temperature:

31th July: 19.6 C, sunny
8th August: 17.6 C, cloudy

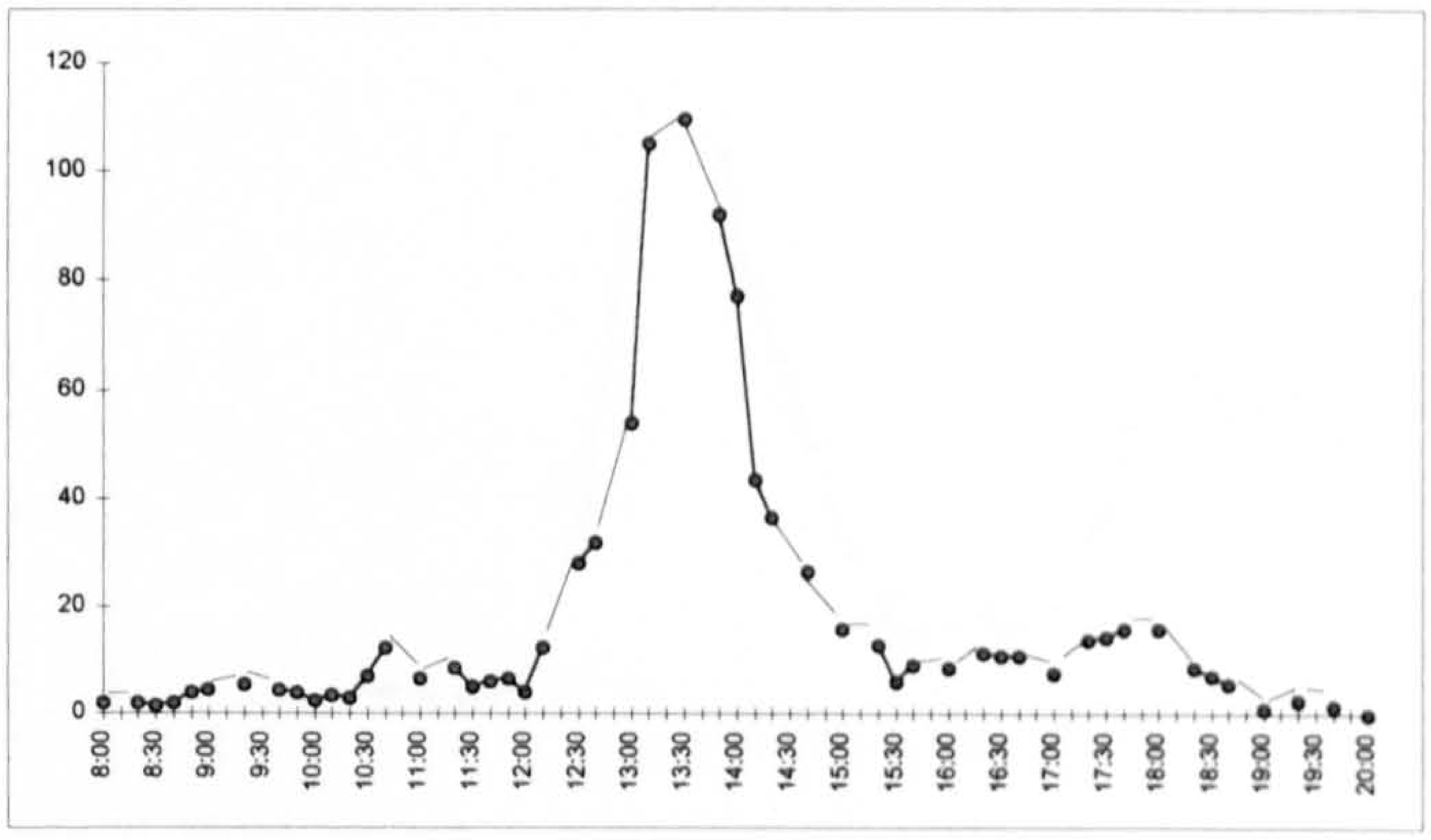


Figure 1. Mean all static

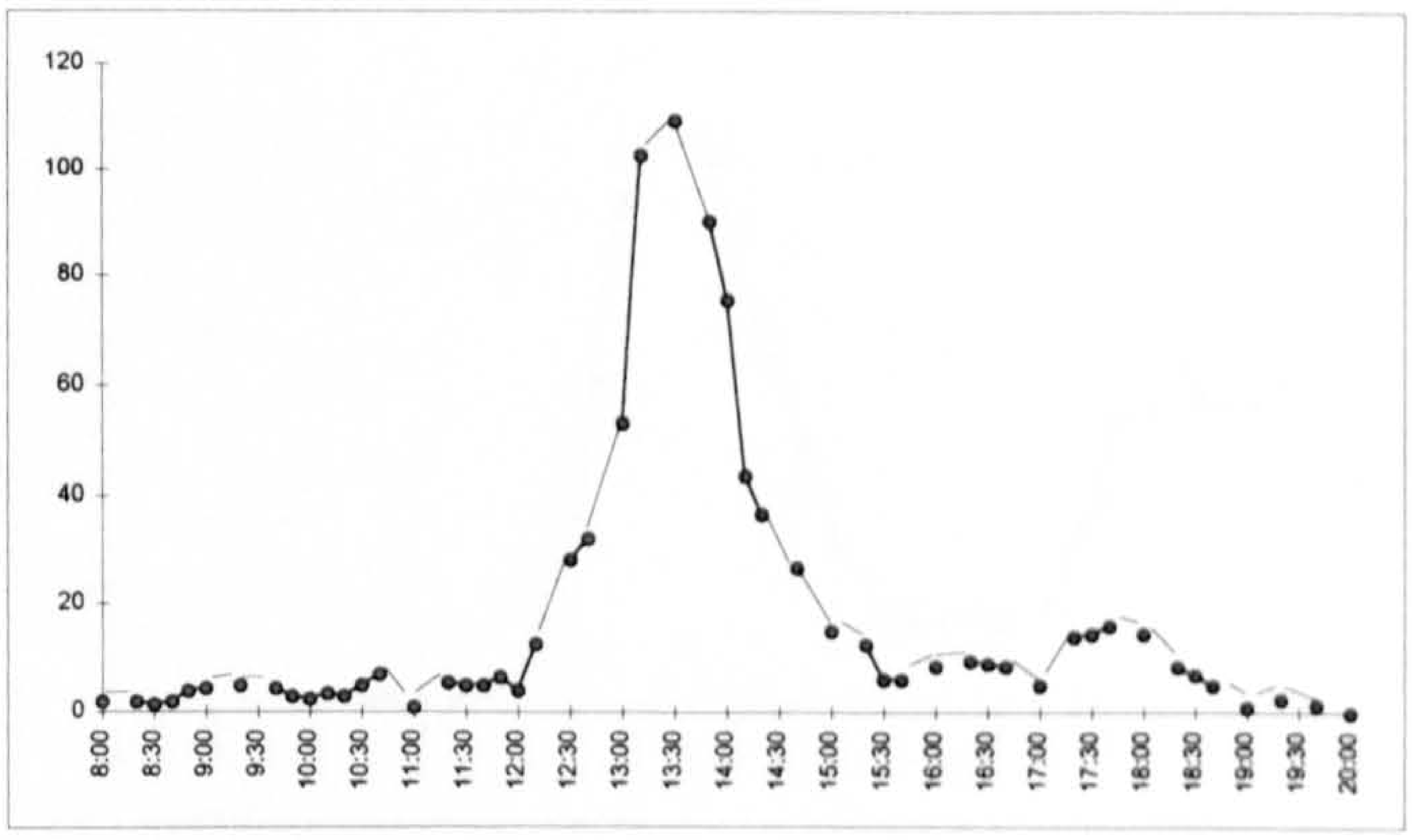


Figure 2. Mean all suits static

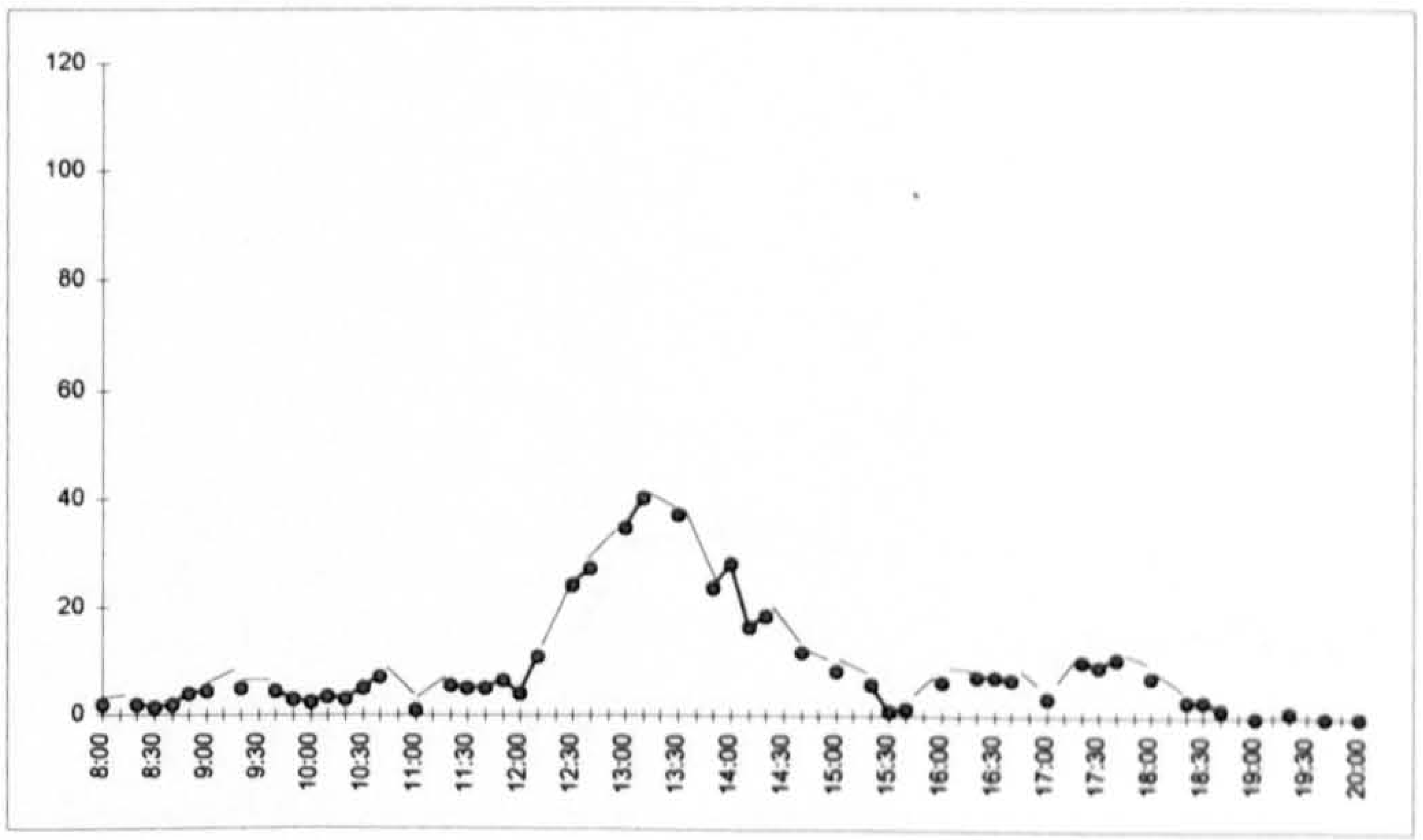


Figure 3. Mean all suits not at pubs static

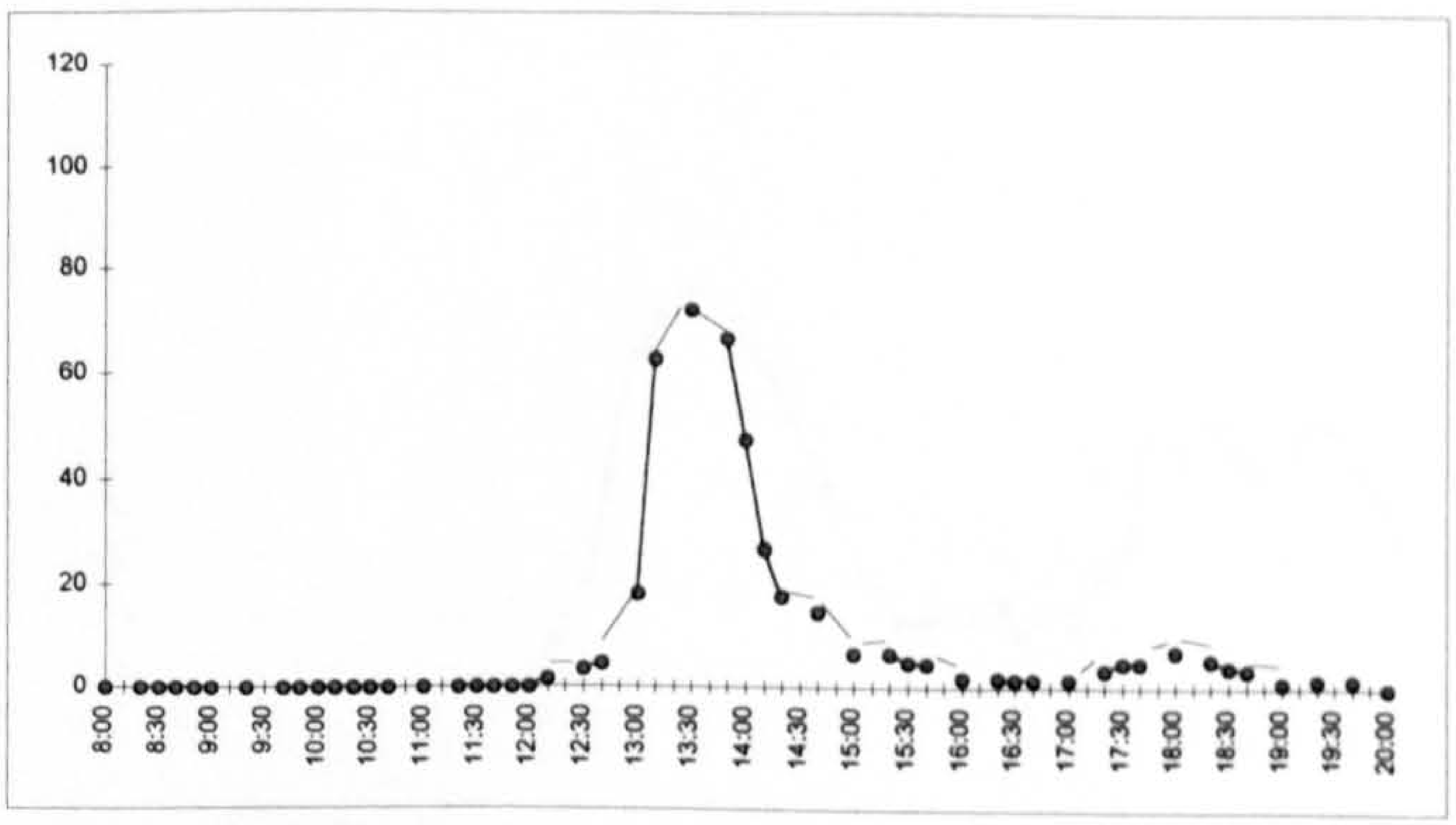


Figure 4. Mean all suits at pubs static

Plate 5.9. Finsbury Av. - Levels of static people distribution throughout the day
Observation: July and August 1996

Time slot	Mean all static	Mean all suits	Mean all suits not at pubs	Mean all suits at pubs
8:00	0.5	0.5	0.5	0
8:10				
8:20	3	2	2	0
8:30	1.5	1.5	1.5	0
8:40	2	2	2	0
8:50	4.5	4.5	4.5	0
9:00	0	0	0	0
9:10				
9:20	3	2	2	0
9:30				
9:40	4	3	3	0
9:50	3	2	2	0
10:00	1.5	0	0	0
10:10	6	2.5	2.5	0
10:20	10.5	3.5	3.5	0
10:30	9	3	3	0
10:40	9.5	5.5	5.5	0
10:50				
11:00	3	3	3	0
11:10				
11:20	5	3.5	1.5	2
11:30	7.5	6	4	2
11:40	8	7.5	5.5	2
11:50	11.5	10.5	9	1.5
12:00	20.5	18.5	11	7.5
12:10	41	39	17.5	21.5
12:20				
12:30	89.5	88	36.5	51.5
12:40	150	150	51	99
12:50				
13:00	235	235	76	159
13:10	255.5	253.5	77.5	176
13:20				
13:30	265.5	263.5	75	188.5
13:40				
13:50	256.5	253.5	79	174.5
14:00	208.5	203.5	45	158.5
14:10	189	187	40	147
14:20	164.5	160.5	35.5	125
14:30				
14:40	123	121.5	28	93.5
14:50				
15:00	73	73	22.5	50.5
15:10				
15:20	46.5	46.5	16	30.5
15:30	33.5	33.5	3.5	30
15:40	37	37	5	32
15:50				
16:00	38.5	38.5	9.5	29
16:10				
16:20	44.5	44.5	7.5	37
16:30	37	37	12.5	24.5
16:40	39	38	6	32
16:50				
17:00	49	48	20	28
17:10				
17:20	87	83	30.5	52.5
17:30	93	93	23.5	69.5
17:40	131.5	131.5	14	117.5
17:50				
18:00	136.5	136.5	30	106.5
18:10				
18:20	157	157	33	124
18:30	142	142	30.5	111.5
18:40	138	138	37	101
18:50				
19:00	138	138	29	109
19:10				
19:20	147.5	147.5	25	122.5
19:30				
19:40	125	125	25.5	99.5
19:50				
20:00	102	102	35.5	66.5

Table 1. Levels of static people throughout the day

The table gives the mean number of static people over two days
Public space with wine bar/pub

Observations carried out on 26th and 30th July 1996

Mean temperature:

26th July: 21.7 C, sunny
30th July: 19.5 C, cloudy

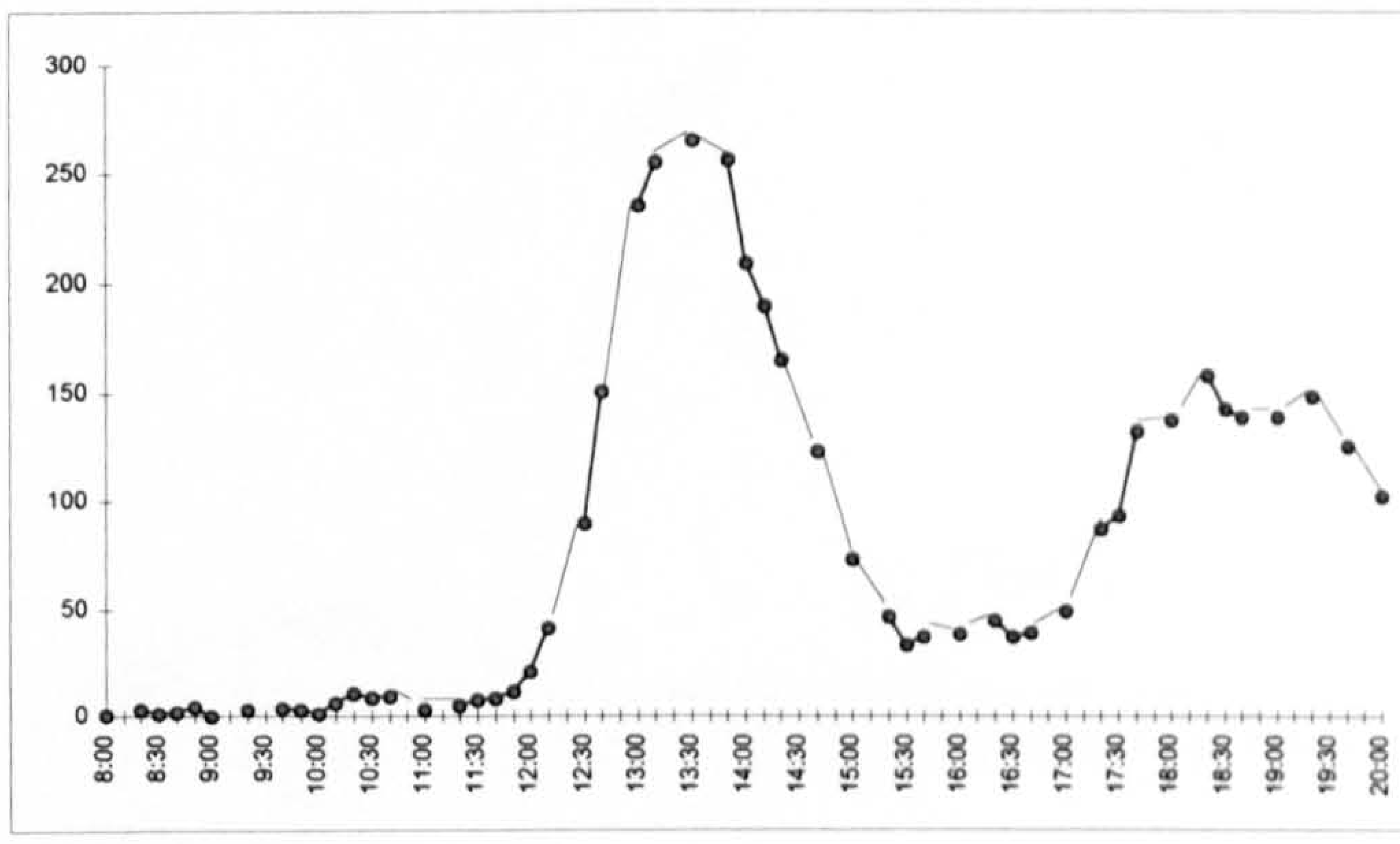


Figure 1. Mean all static

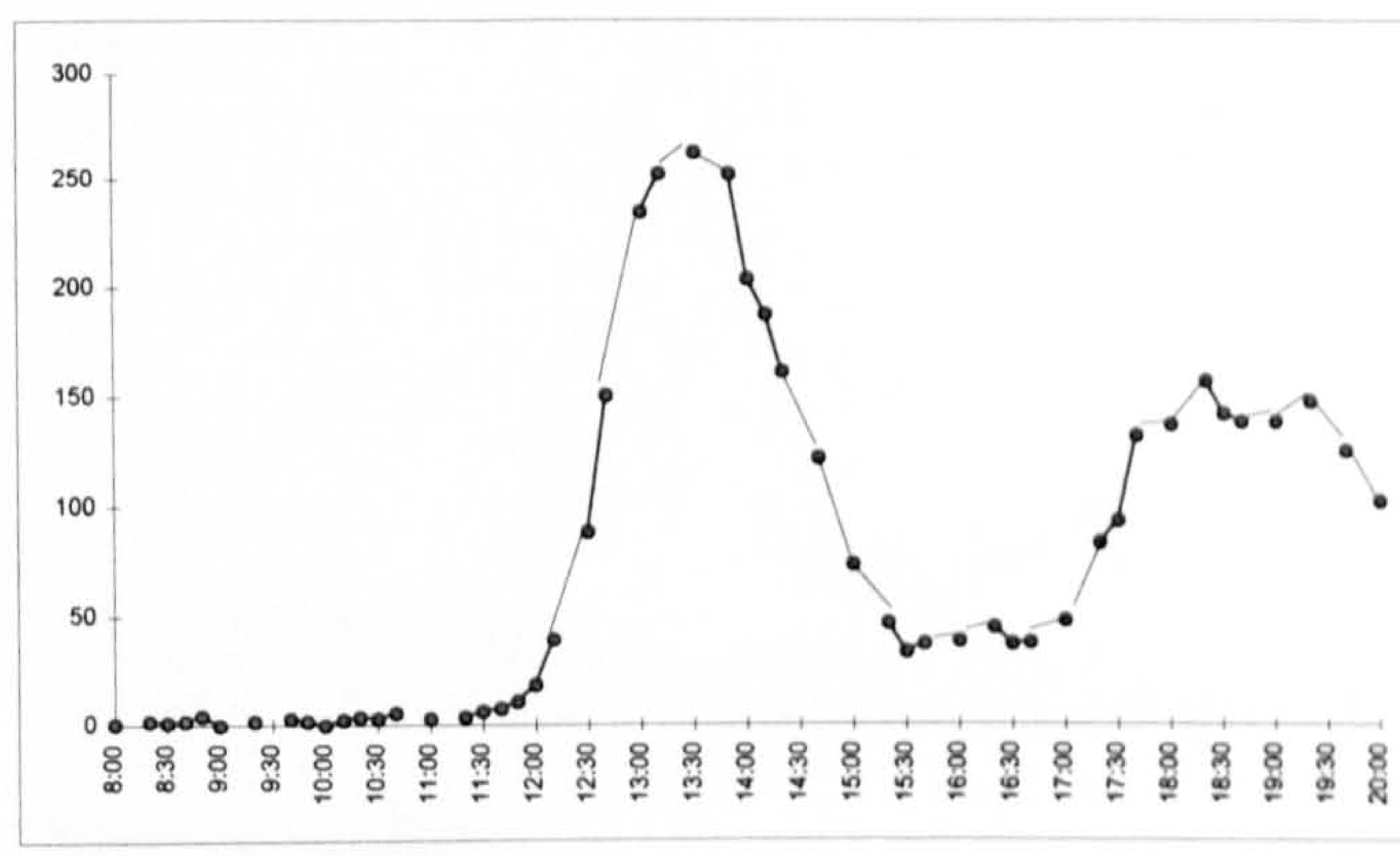


Figure 2. Mean all suits static

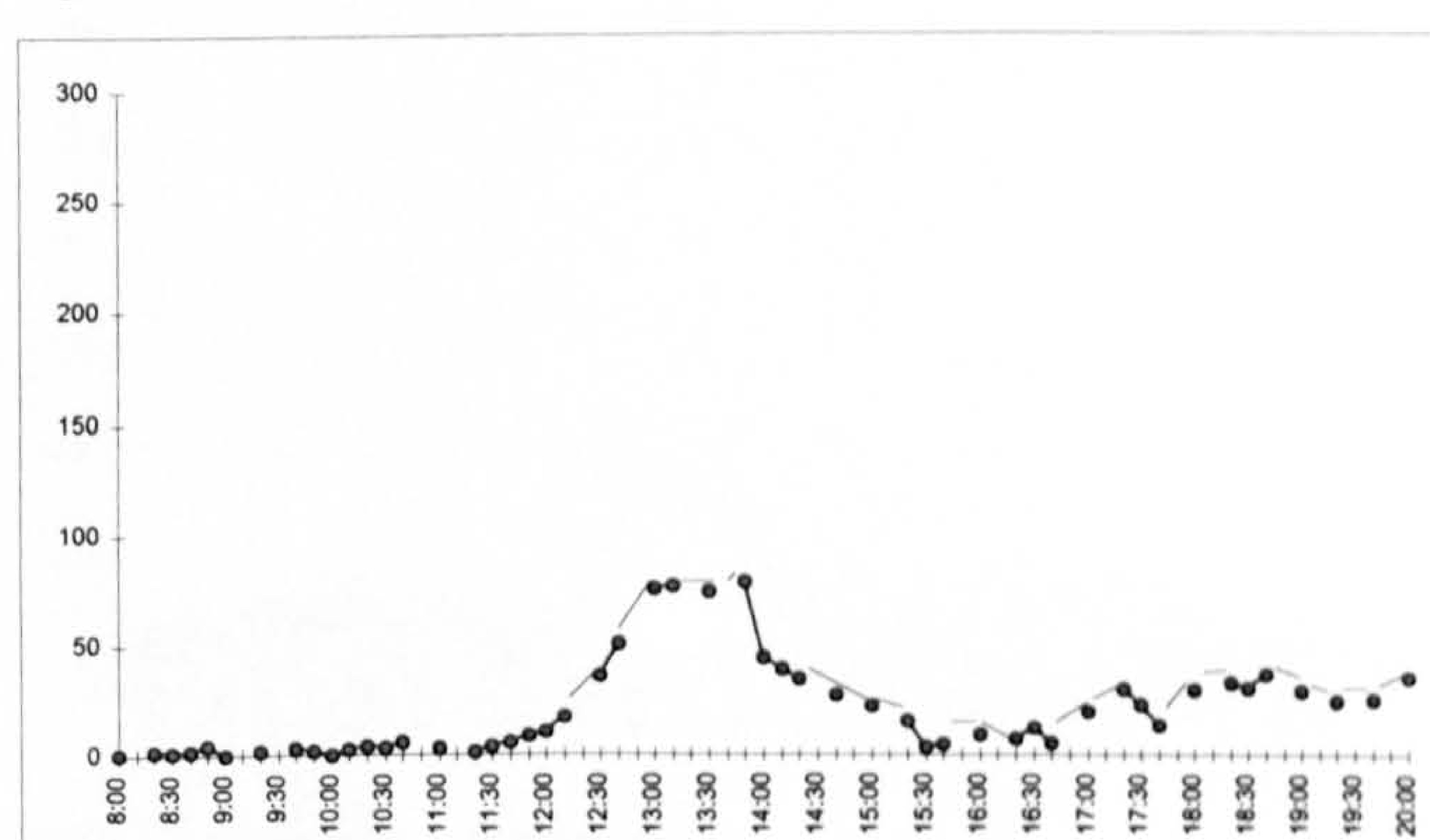


Figure 3. Mean all suits not at pubs static

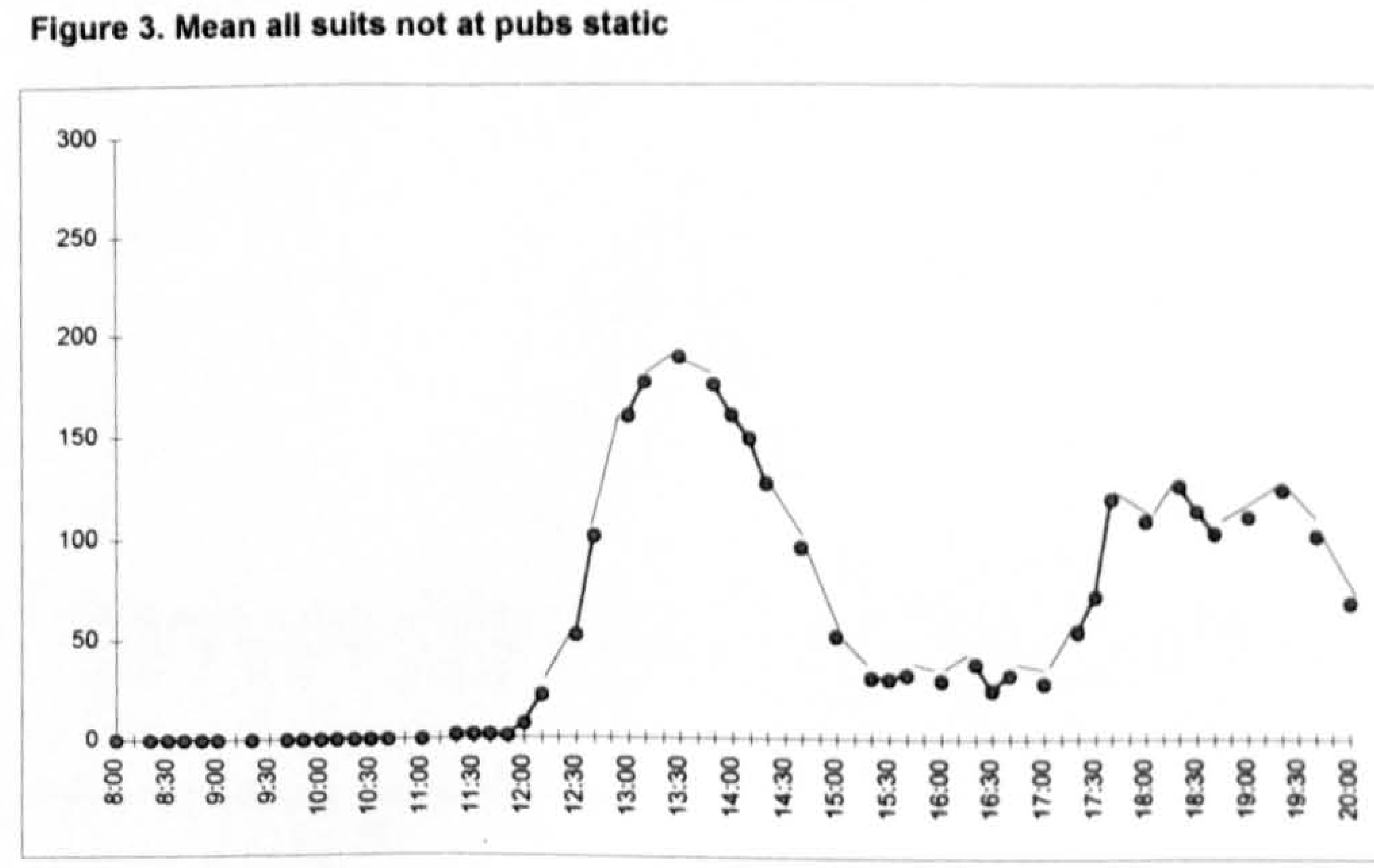


Figure 4. Mean all suits at pubs static

Plate 5.10. Fleet Place - Levels of static people distribution throughout the day
Observation: July and August 1996

Time slot	Mean all static	Mean all suits	Mean all suits not at pubs	Mean all suits at pubs
8:00	1.5	1.5	1.5	0
8:10				
8:20	1.5	1.5	1.5	0
8:30	3	3	3	0
8:40	2.5	2.5	2.5	0
8:50	1.5	0.5	0.5	0
9:00	4.5	2.5	2.5	0
9:10				
9:20	4.5	4.5	4.5	0
9:30				
9:40	6.5	5.5	5.5	0
9:50	7	3	3	0
10:00	7	6	6	0
10:10	3.5	3.5	3.5	0
10:20	6	4	4	0
10:30	8	6	6	0
10:40	4.5	3	3	0
10:50				
11:00	6.5	3.5	3.5	0
11:10				
11:20	9	7.5	5.5	2
11:30	7	4	3	1
11:40	3.5	2.5	1.5	1
11:50	2	1	1	0
12:00	2.5	2.5	2.5	0
12:10	4	4	4	0
12:20				
12:30	18	16	6.5	9.5
12:40	31.5	31.5	12	19.5
12:50				
13:00	39	39	14.5	24.5
13:10	55	55	18.5	36.5
13:20				
13:30	57.5	57.5	17.5	40
13:40				
13:50	59.5	57	20.5	36.5
14:00	45	42.5	13	29.5
14:10	34.5	34.5	7	27.5
14:20	34.5	32	7	25
14:30				
14:40	26	24.5	6	18.5
14:50				
15:00	15	12.5	7	5.5
15:10				
15:20	8	7	3.5	3.5
15:30	10	7.5	3	4.5
15:40	8.5	8.5	6	2.5
15:50				
16:00	6	6	4	2
16:10				
16:20	13	12	9	3
16:30	11.5	9.5	6	3.5
16:40	9.5	9.5	4.5	5
16:50				
17:00	11	11	7	4
17:10				
17:20	13.5	13.5	8	5.5
17:30	14.5	14.5	8	6.5
17:40	9	9	1	8
17:50				
18:00	43	42.5	5.5	37
18:10				
18:20	49	49	3	46
18:30	52.5	52	1.5	50.5
18:40	53	53	0.5	52.5
18:50				
19:00	47.5	47.5	1.5	46
19:10				
19:20	46.5	46.5	1	45.5
19:30				
19:40	32.5	32.5	0	32.5
19:50				
20:00	25.5	25.5	0	25.5

Table 1. Levels of static people throughout the day

The table gives the mean number of static people over two days
Public space with wine bar/pub

Observations carried out on 30th July and 2nd August 1996

Mean temperature:

30th July: 19.6 C, cloudy
2nd August: 16.6 C, sunny in the morning

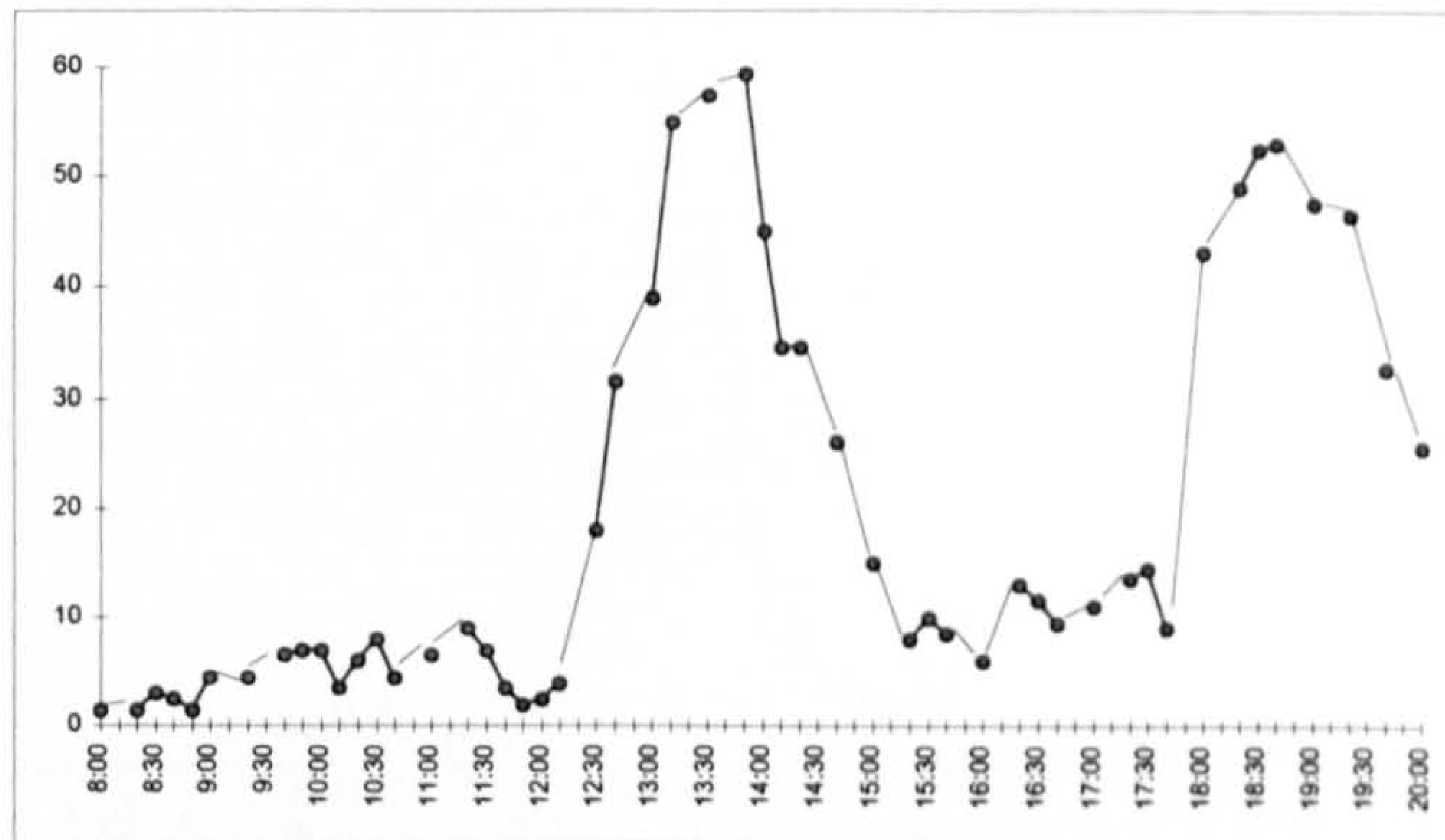


Figure 1. Mean all static

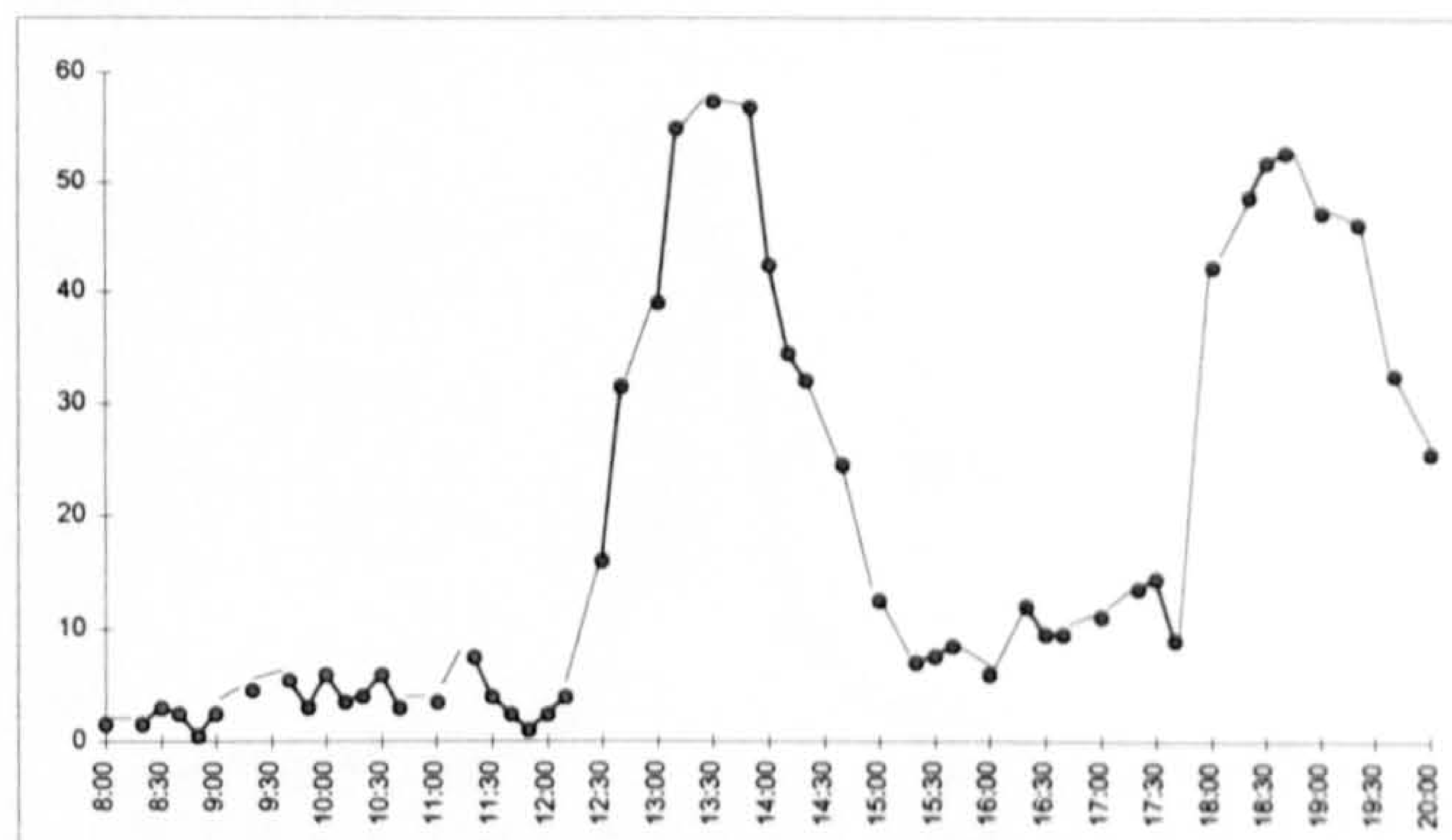


Figure 2. Mean all suits static

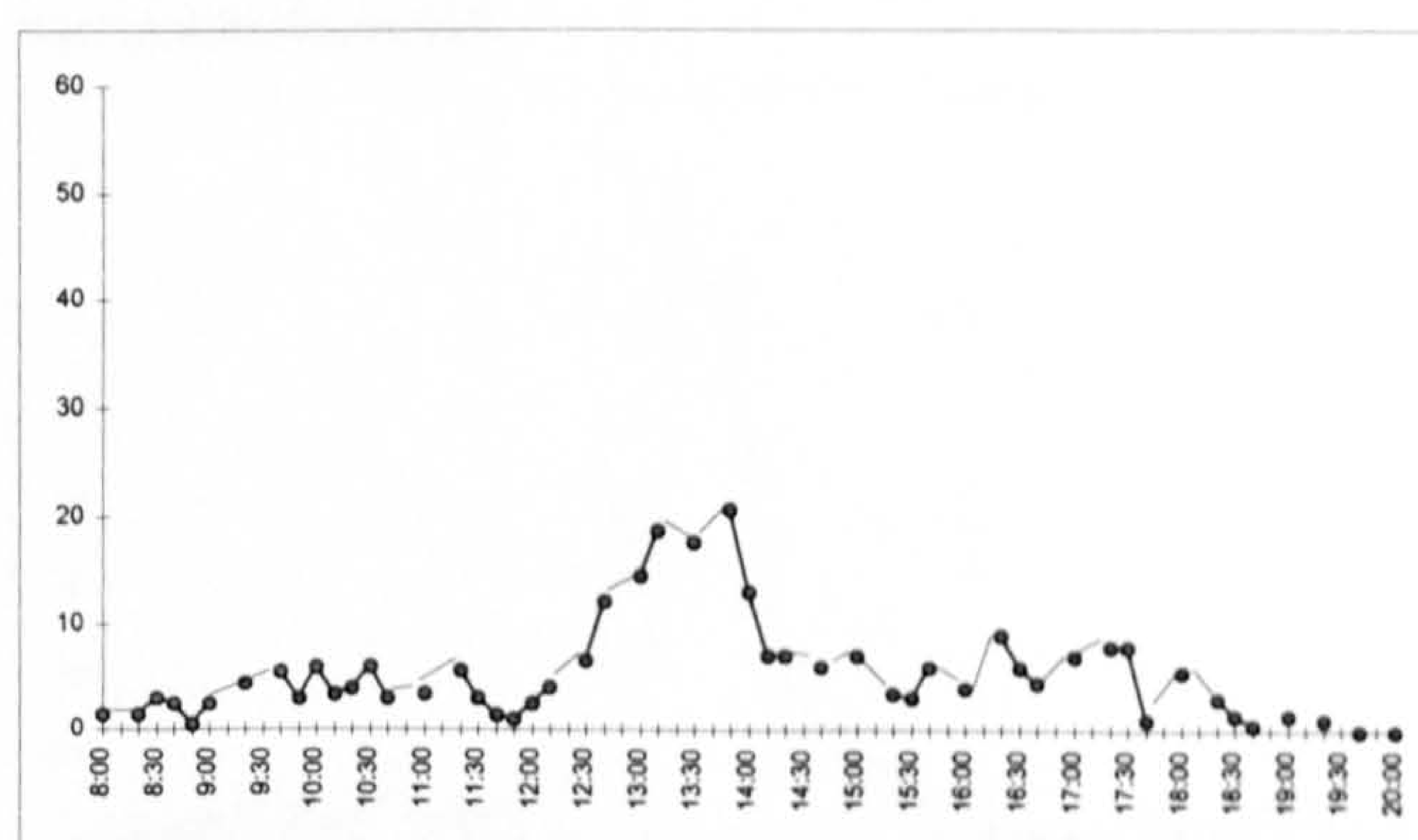


Figure 3. Mean all suits not at pubs static

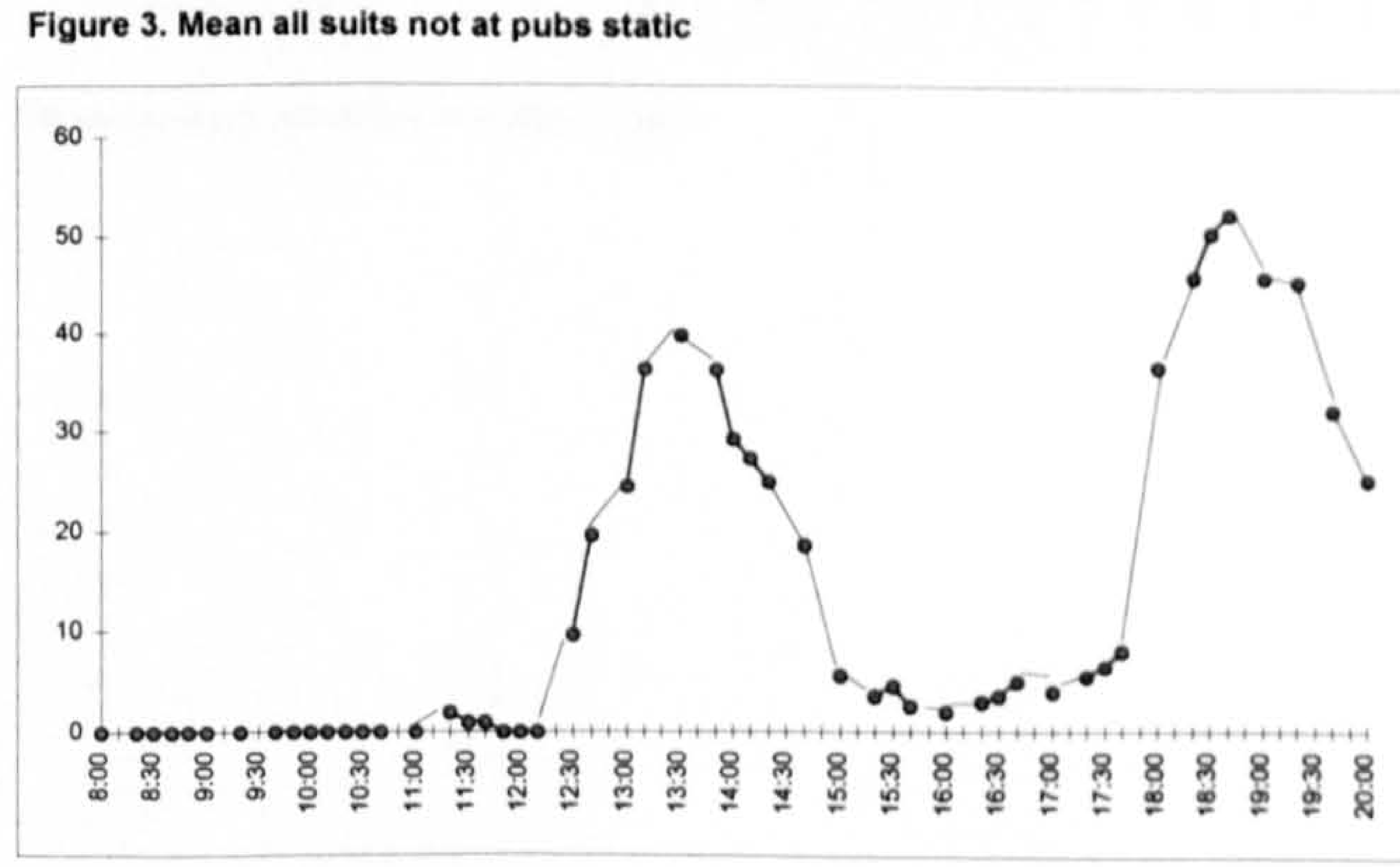


Figure 4. Mean all suits at pubs static

Plate 5.11. Love Lane Corner - Levels of static people distribution throughout the day
Observation: July and August 1996

Time slot	Mean all static	Mean all suits	Mean all suits not at pubs
8:00	0	0	0
8:10			
8:20	1	1	1
8:30	1	1	1
8:40	1.5	1.5	1.5
8:50	2	2	2
9:00	2.5	2.5	2.5
9:10			
9:20	3.5	3.5	3.5
9:30			
9:40	2.5	2	2
9:50	4	3.5	3.5
10:00	4	2	2
10:10	4.5	2.5	2.5
10:20	7.5	5	5
10:30	6.5	4.5	4.5
10:40	6.5	6.5	6.5
10:50			
11:00	2.5	2.5	2.5
11:10			
11:20	3	3	3
11:30	1	1	1
11:40	5	4	4
11:50	7.5	7.5	7.5
12:00	8	8	8
12:10	7.5	7	7
12:20			
12:30	22	21.5	21.5
12:40	42.5	39	39
12:50			
13:00	26.5	24	24
13:10	80	77	77
13:20			
13:30	65	65	65
13:40			
13:50	45.5	45.5	45.5
14:00	27.5	27.5	27.5
14:10	21.5	21	21
14:20	16	16	16
14:30			
14:40	10.5	10.5	10.5
14:50			
15:00	9.5	9.5	9.5
15:10			
15:20	5.5	5	5
15:30	1.5	1.5	1.5
15:40	2	2	2
15:50			
16:00	2	2	2
16:10			
16:20	0.5	0.5	0.5
16:30	0.5	0.5	0.5
16:40	1	1	1
16:50			
17:00	0.5	0.5	0.5
17:10			
17:20	2.5	2.5	2.5
17:30	3.5	3.5	3.5
17:40	2	1.5	1.5
17:50			
18:00	1	0.5	0.5
18:10			
18:20	2.5	2	2
18:30	5	4.5	4.5
18:40	4	3.5	3.5
18:50			
19:00	2	2	2
19:10			
19:20	1	1	1
19:30			
19:40	0.5	0.5	0.5
19:50			
20:00	0	0	0

Table 1. Levels of static people throughout the day

The table gives the mean number of static people over two days
Public space without wine bar/pub

Observations carried out on 22nd July and 2nd August 1996

Mean temperature:

22nd July: 24.7, sunny
2nd August: 16.6 C, sunny in the morning

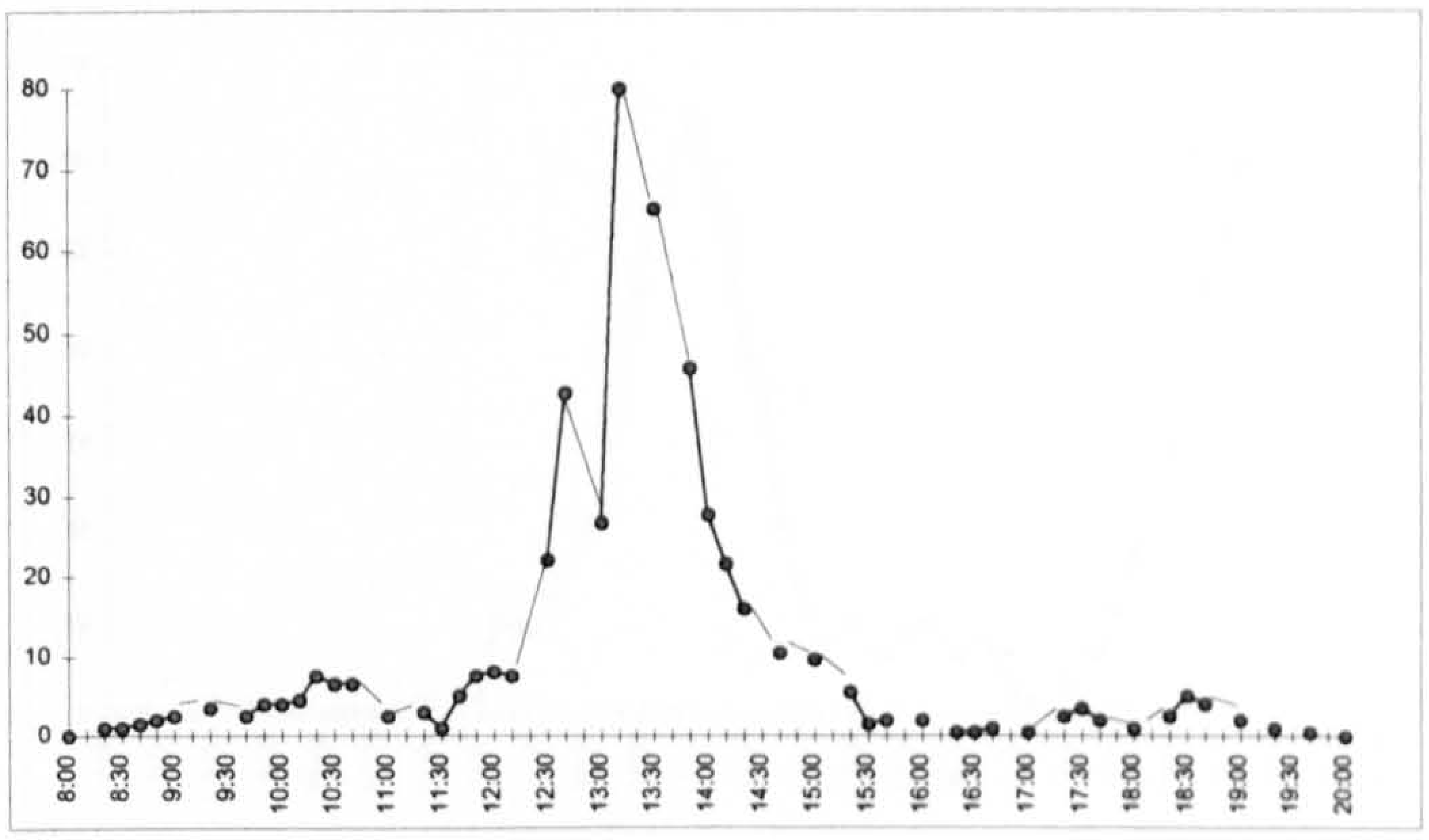


Figure 1. Mean all static

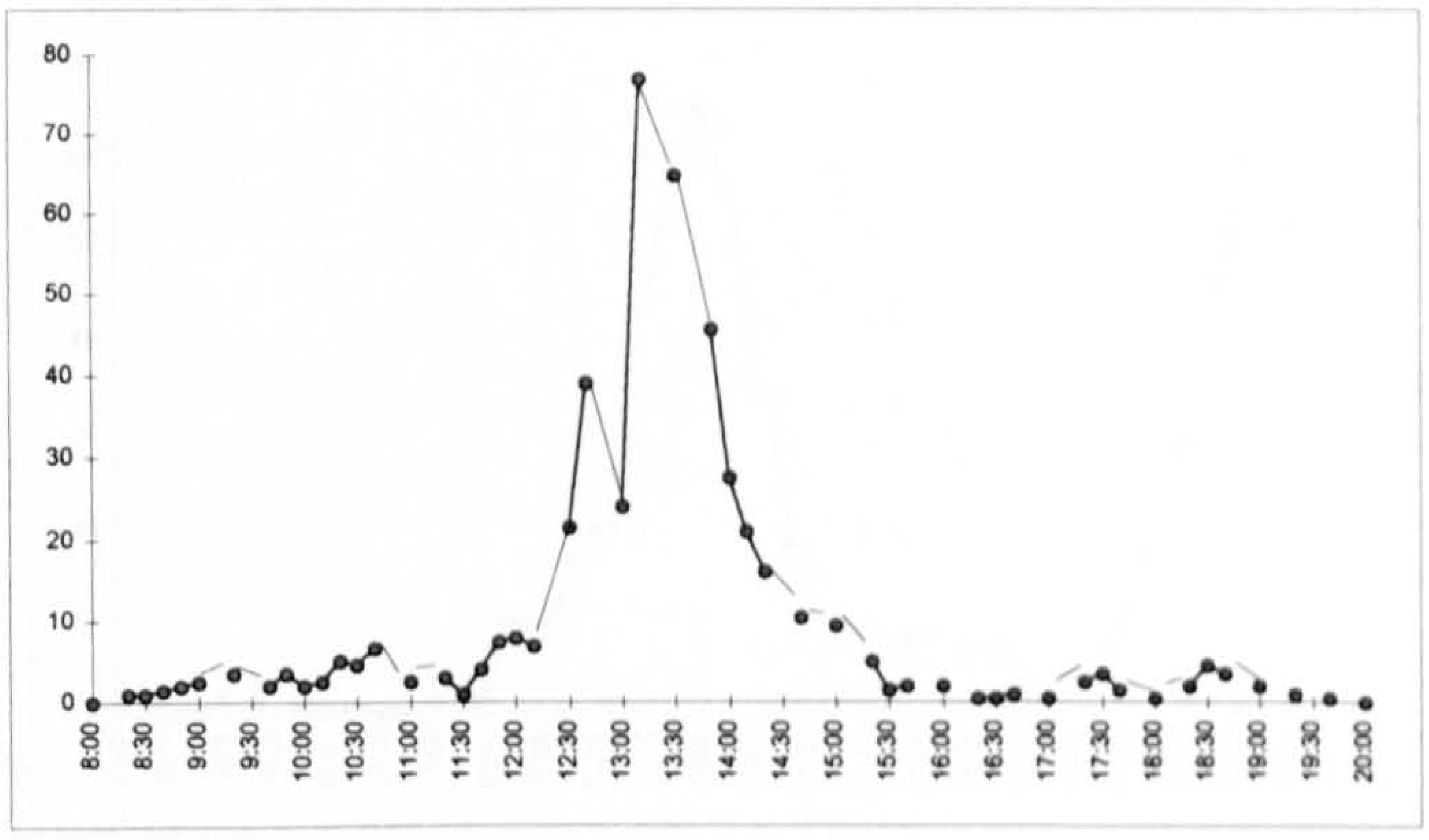


Figure 2. Mean all suits static

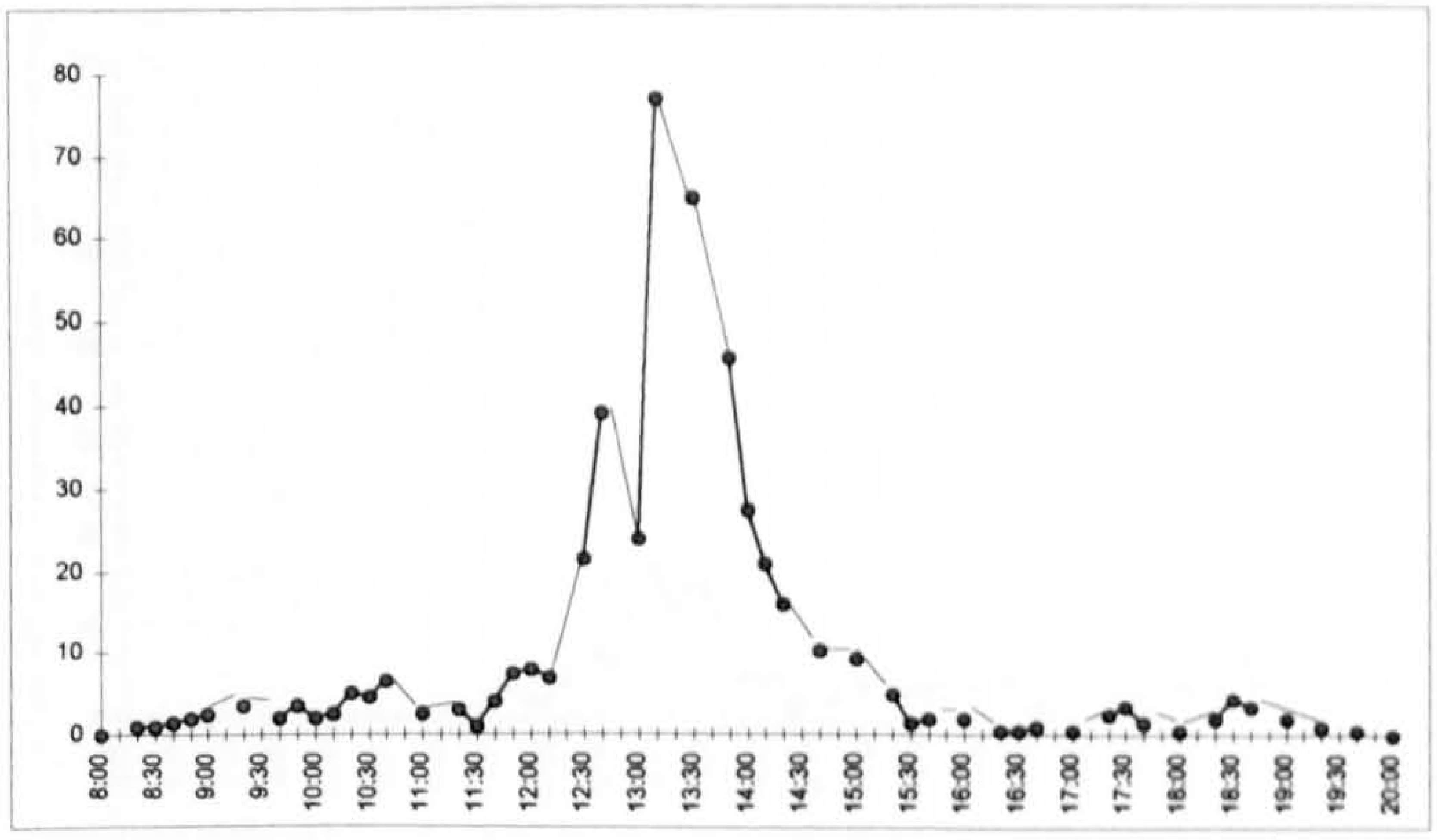


Figure 3. Mean all suits not at pubs static

Plate 5.12. New Change/Cheapside Corner - Levels of static people distribution throughout the day
Observation: July and August 1996

Time slot	Mean all static	Mean all suits	Mean all suits not at pubs	Mean all suits at pubs
8:00	0.5	0.5	0.5	0
8:10				
8:20	0.5	0.5	0.5	0
8:30	0	0	0	0
8:40	0	0	0	0
8:50	0	0	0	0
9:00	1.5	1.5	1.5	0
9:10				
9:20	1	1	1	0
9:30				
9:40	0.5	0.5	0.5	0
9:50	0.5	0.5	0.5	0
10:00	0	0	0	0
10:10	0.5	0.5	0.5	0
10:20	0.5	0.5	0.5	0
10:30	0	0	0	0
10:40	0	0	0	0
10:50				
11:00	1.5	1.5	1.5	0
11:10				
11:20	1.5	1.5	1.5	0
11:30	2	2	2	0
11:40	10	10	3.5	6.5
11:50	9.5	9.5	2.5	7
12:00	9	9	2	7
12:10	13	12	4.5	7.5
12:20				
12:30	19.5	19.5	7	12.5
12:40	22.5	20.5	6	14.5
12:50				
13:00	45.5	45.5	16	29.5
13:10	55.5	53.5	12.5	41
13:20				
13:30	65	65	14	51
13:40				
13:50	53.5	52.5	4.5	48
14:00	39	35.5	5	30.5
14:10	35	34	5	29
14:20	20.5	18	1	17
14:30				
14:40	6.5	6.5	2.5	4
14:50				
15:00	9.5	9.5	3.5	6
15:10				
15:20	6.5	6.5	3	3.5
15:30	8.5	8	3.5	4.5
15:40	9.5	8.5	3.5	5
15:50				
16:00	6	6	4	2
16:10				
16:20	7	6.5	4.5	2
16:30	2.5	2.5	1.5	1
16:40	1	1	1	0
16:50				
17:00	3.5	3.5	0	3.5
17:10				
17:20	6.5	6.5	2	4.5
17:30	11	11	2.5	8.5
17:40	17.5	17.5	1.5	16
17:50				
18:00	28.5	28.5	3.5	25
18:10				
18:20	45.5	45.5	3.5	42
18:30	51.5	51.5	7.5	44
18:40	59.5	59.5	4	55.5
18:50				
19:00	53	53	2	51
19:10				
19:20	56	56	1	55
19:30				
19:40	46	46	1.5	44.5
19:50				
20:00	37.5	37.5	4	33.5

Table 1. Levels of static people throughout the day

The table gives the mean number of static people over two days
Public space with wine bar/pub

Observations carried out on 22nd July and 3rd August 1996

Mean temperature:

22nd July: 24.7 C, sunny
3rd August: 18.1 C, sunny

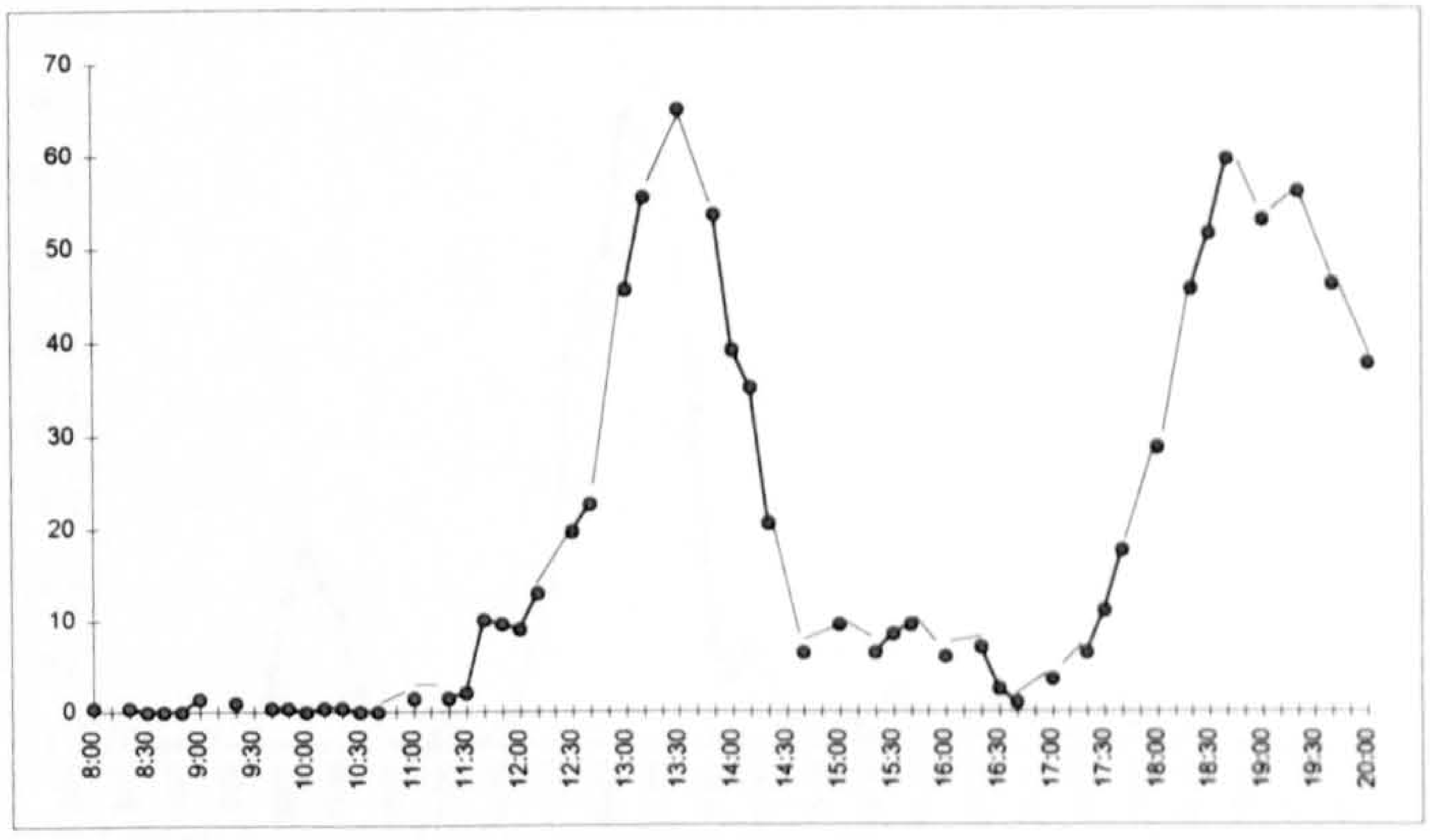


Figure 1. Mean all static

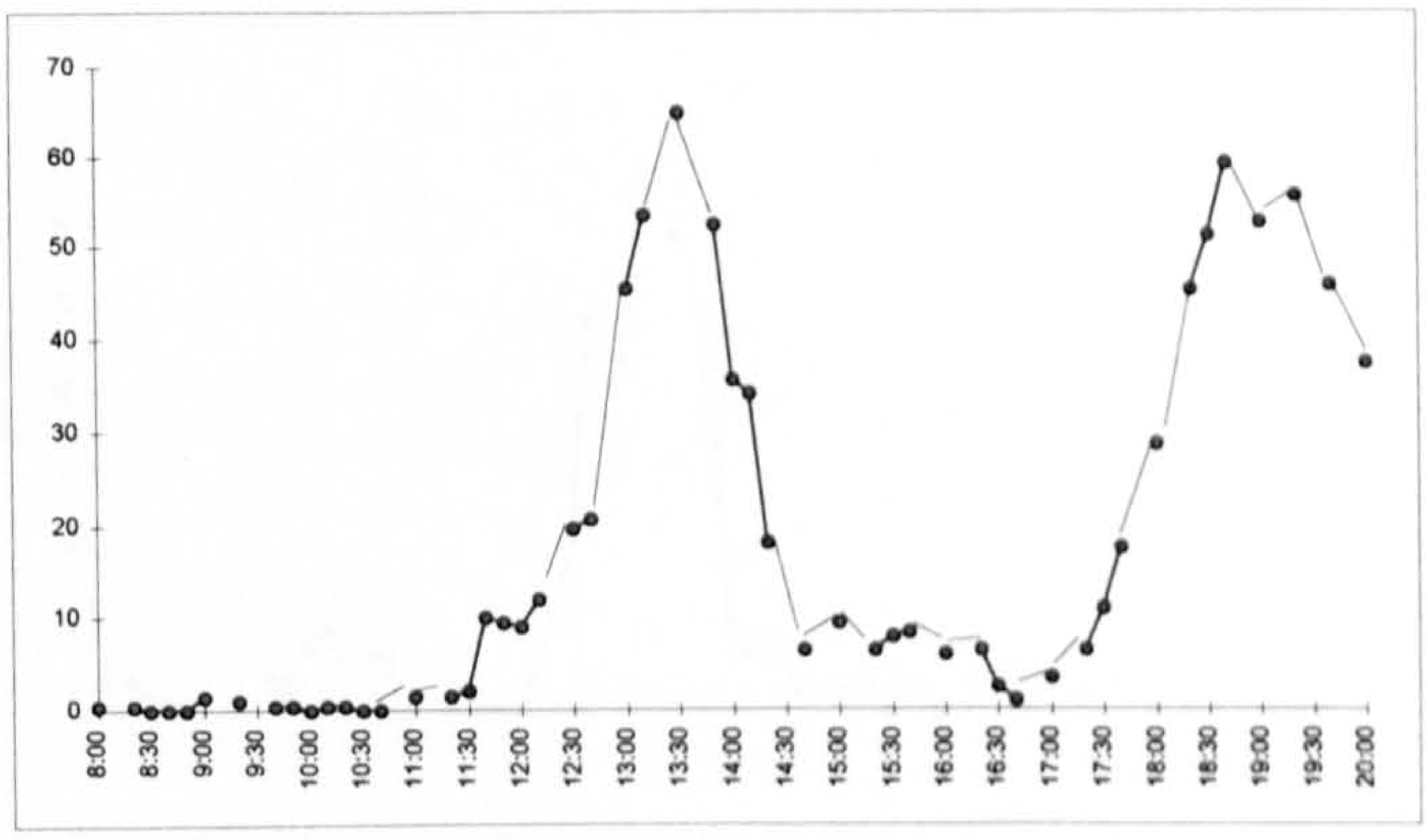


Figure 2. Mean all suits static

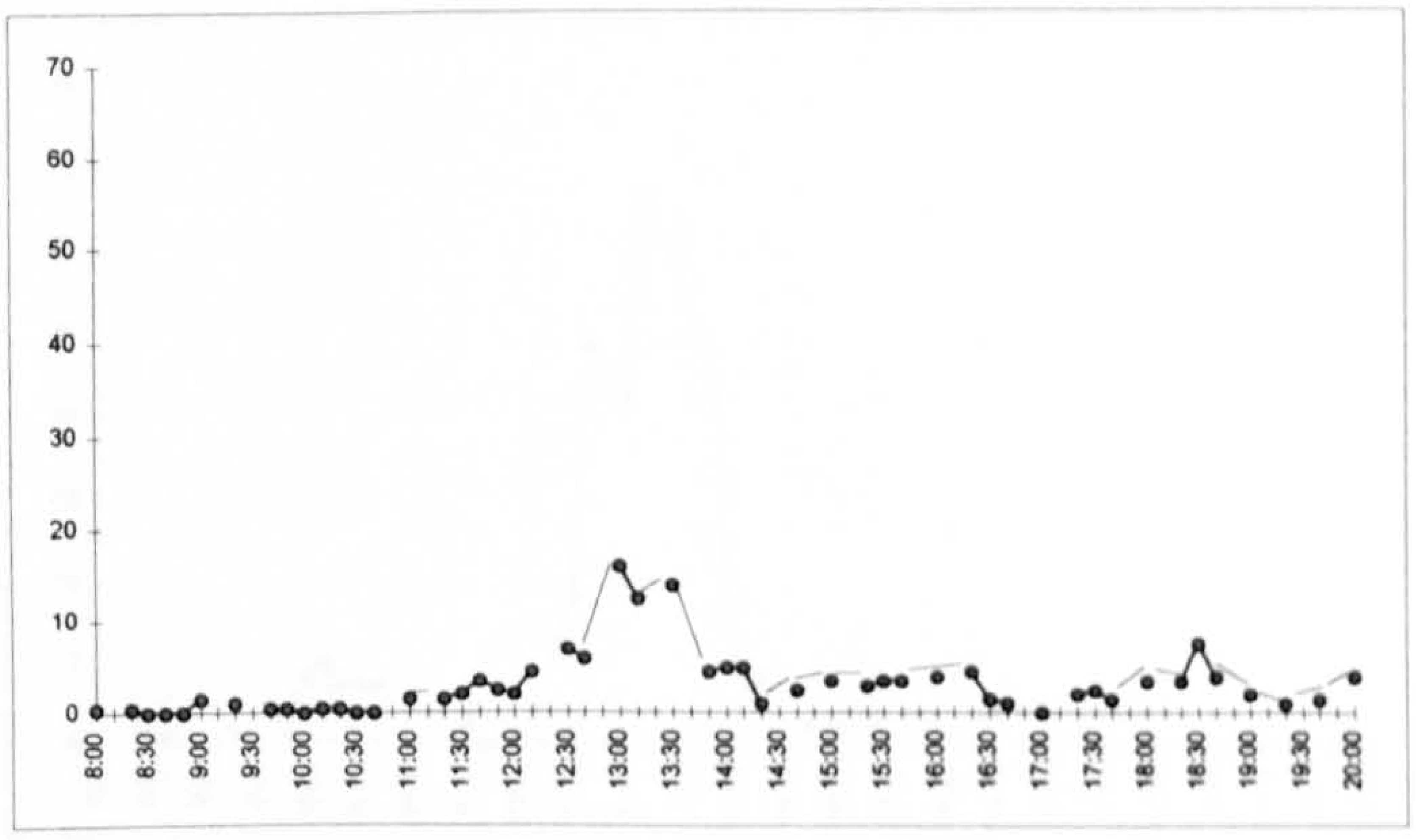


Figure 3. Mean all suits not at pubs static

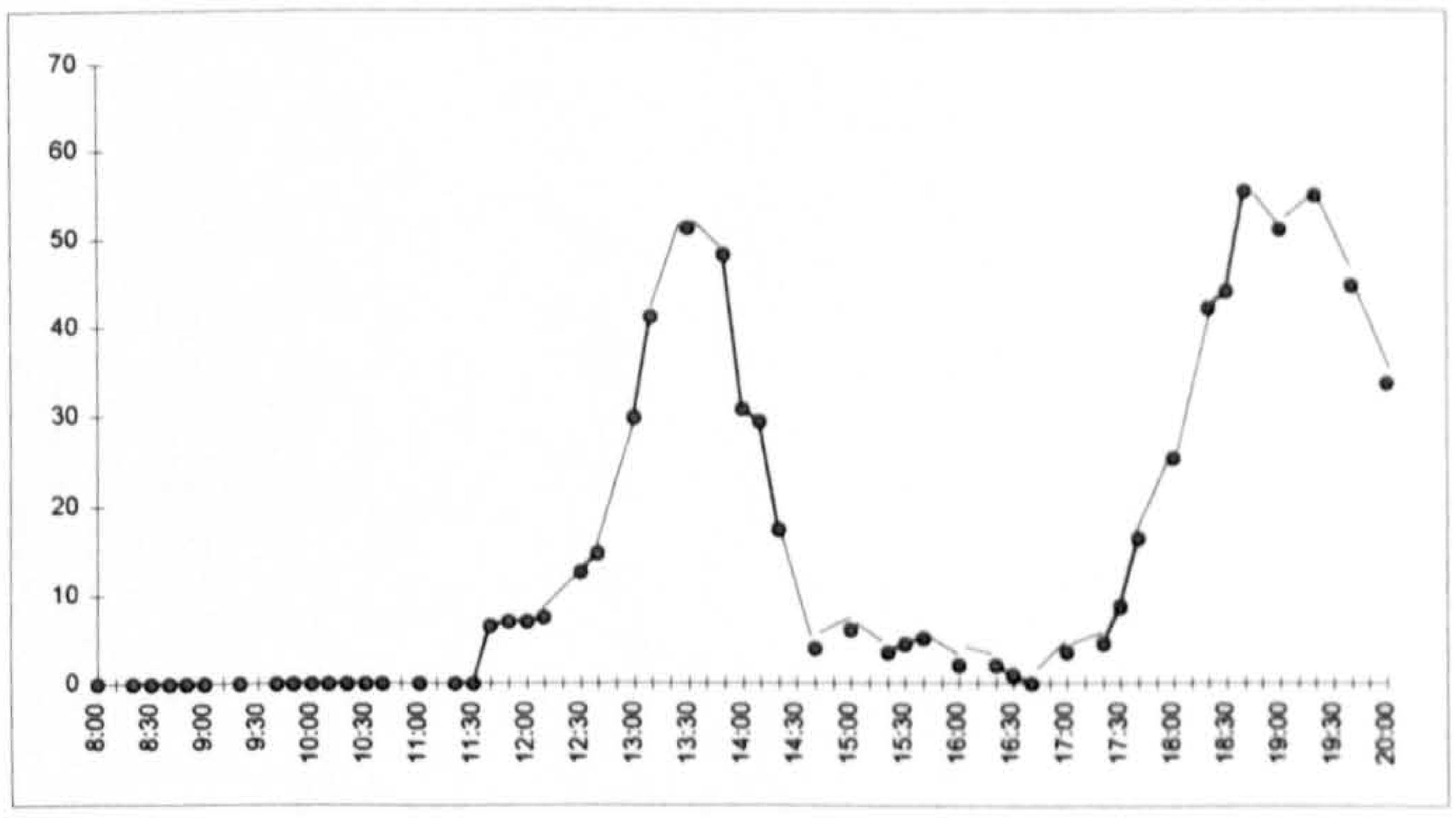


Figure 4. Mean all suits at pubs static

Plate 5.13. North Guildhall - Levels of static people distribution throughout the day
Observation: July and August 1996

Time slot	Mean all static	Mean all suits	Mean all suits not at pubs
8:00	0	0	0
8:10			
8:20	2	2	2
8:30	0.5	0.5	0.5
8:40	0.5	0.5	0.5
8:50	0	0	0
9:00	0	0	0
9:10			
9:20	0.5	0.5	0.5
9:30			
9:40	2	2	2
9:50	3	1	1
10:00	9	4	4
10:10	12.5	5	5
10:20	10	3.5	3.5
10:30	8	3.5	3.5
10:40	3.5	3.5	3.5
10:50			
11:00	0	0	0
11:10			
11:20	0	0	0
11:30	1.5	1.5	1.5
11:40	0.5	0	0
11:50	0	0	0
12:00	1	0	0
12:10	2	2	2
12:20			
12:30	10	9	9
12:40	24	24	24
12:50			
13:00	30.5	21	21
13:10	39	33	33
13:20			
13:30	35.5	29.5	29.5
13:40			
13:50	21	21	21
14:00	6.5	6	6
14:10	4.5	3.5	3.5
14:20	6	4.5	4.5
14:30			
14:40	1.5	1	1
14:50			
15:00	1	1	1
15:10			
15:20	1.5	1.5	1.5
15:30	0	0	0
15:40	3.5	1.5	1.5
15:50			
16:00	0	0	0
16:10			
16:20	1.5	1.5	1.5
16:30	2	2	2
16:40	2.5	2.5	2.5
16:50			
17:00	1.5	1.5	1.5
17:10			
17:20	1	1	1
17:30	0	0	0
17:40	2	2	2
17:50			
18:00	1.5	0	0
18:10			
18:20	0	0	0
18:30	1	0	0
18:40	0	0	0
18:50			
19:00	0	0	0
19:10			
19:20	0	0	0
19:30			
19:40	0	0	0
19:50			
20:00	0	0	0

Table 1. Levels of static people throughout the day

The table gives the mean number of static people over two days
Public space without wine bar/pub

Observations carried out on 22nd July and 2nd August 1996

Mean temperature:

22nd July: 24.7 C, sunny
2nd August: 16.6 C, sunny in the morning

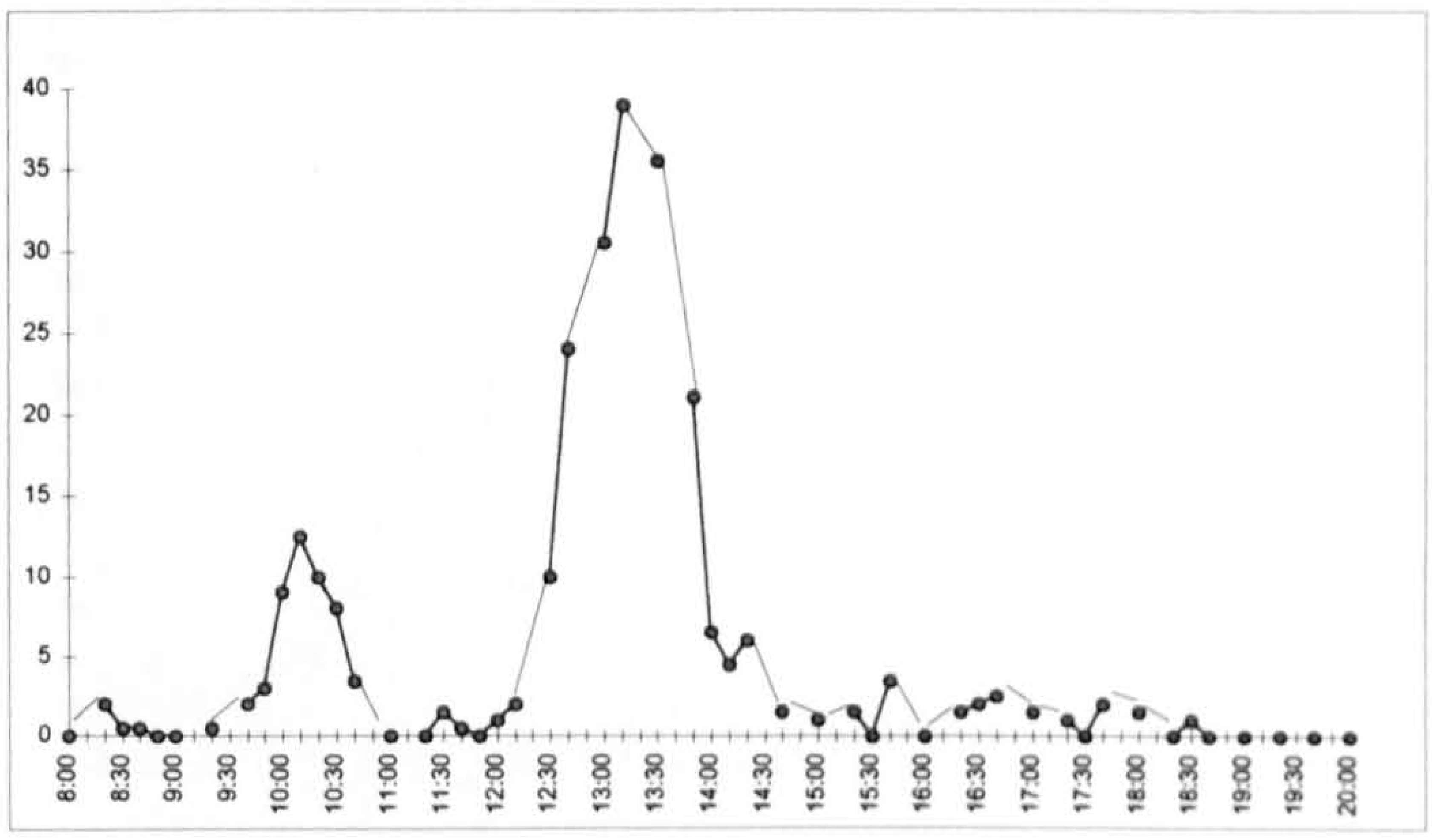


Figure 1. Mean all static

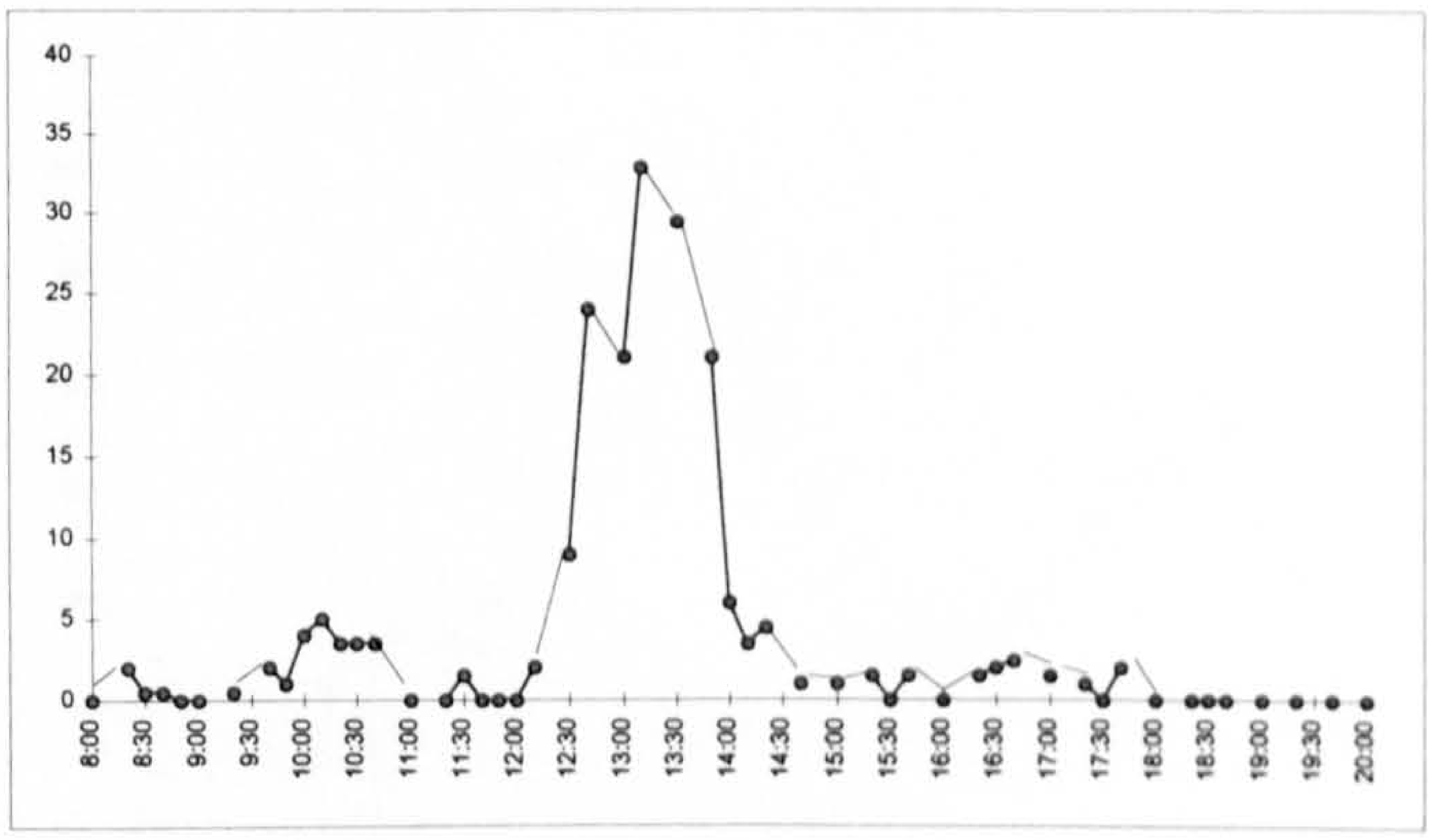


Figure 2. Mean all suits static

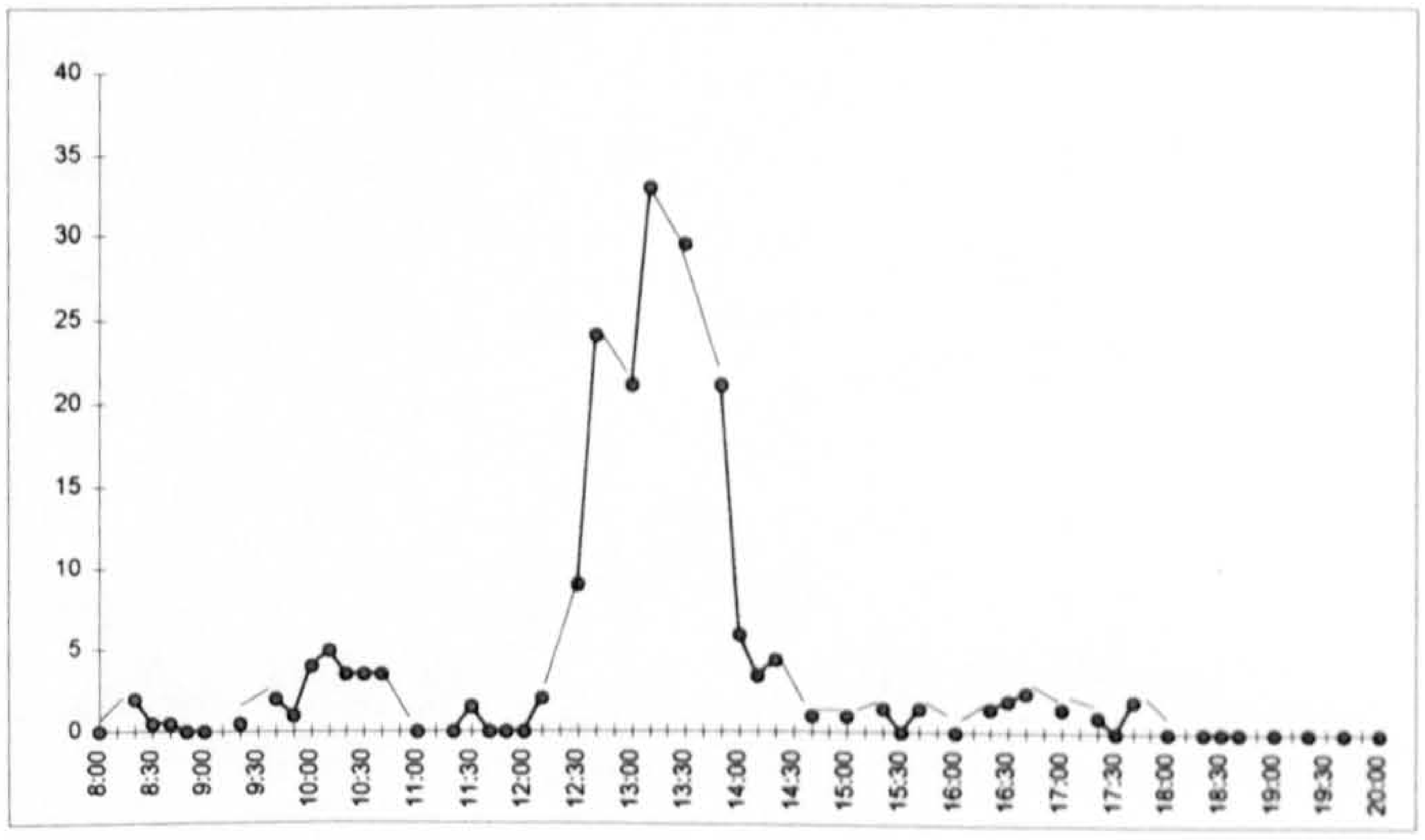


Figure 3. Mean all suits not at pubs static

Plate 5.14. Royal Exchange - Levels of static people distribution throughout the day
Observation: July and August 1996

Time slot	Mean all static	Mean all suits	Mean all suits not at pubs	Mean all suits at pubs
8:00	0.5	0.5	0.5	0
8:10				
8:20	3	2	2	0
8:30	10	10	10	0
8:40	5	4.5	4.5	0
8:50	2	2	2	0
9:00	4	4	4	0
9:10				
9:20	5.5	4.5	4.5	0
9:30				
9:40	7.5	4.5	4.5	0
9:50	11.5	7	7	0
10:00	10.5	4	4	0
10:10	19	5.5	5.5	0
10:20	23	9	8	1
10:30	19.5	8	6	2
10:40	25.5	13	6.5	6.5
10:50				
11:00	26.5	19.5	5.5	14
11:10				
11:20	20.5	12.5	3.5	9
11:30	17	11.5	4.5	7
11:40	21.5	20.5	9.5	11
11:50	23.5	21.5	8	13.5
12:00	39.5	31.5	12.5	19
12:10	51	45	17.5	27.5
12:20				
12:30	58.5	56.5	25.5	31
12:40	77.5	68	23.5	44.5
12:50				
13:00	96	82.5	27	55.5
13:10	119	99	33.5	65.5
13:20				
13:30	110.5	104.5	35.5	69
13:40				
13:50	102	97	29.5	67.5
14:00	81	77.5	25	52.5
14:10	65	64	22.5	41.5
14:20	59	57	21	36
14:30				
14:40	43	40	19.5	20.5
14:50				
15:00	33	27	14.5	12.5
15:10				
15:20	16	14	6	8
15:30	12.5	9	4.5	4.5
15:40	14	10	4.5	5.5
15:50				
16:00	9.5	9.5	6	3.5
16:10				
16:20	18.5	15	5.5	9.5
16:30	18	17	4	13
16:40	21.5	20.5	3.5	17
16:50				
17:00	21.5	21.5	9	12.5
17:10				
17:20	34.5	32	9	23
17:30	37.5	36	7.5	28.5
17:40	46.5	43	8	35
17:50				
18:00	48	44.5	4	40.5
18:10				
18:20	61.5	58	4.5	53.5
18:30	56	56	4	52
18:40	52.5	52.5	2	50.5
18:50				
19:00	35	34.5	3	31.5
19:10				
19:20	26.5	26.5	1.5	25
19:30				
19:40	19.5	19.5	0.5	19
19:50				
20:00	12.5	12.5	0.5	12

Table 1. Levels of static people throughout the day

The table gives the mean number of static people over two days
Public space with wine bar/pub

Observations carried out on 17th and 19th July 1996

Mean temperature:

17th July: 16.8 C, sunny
19th July: 19.1 C, sunny

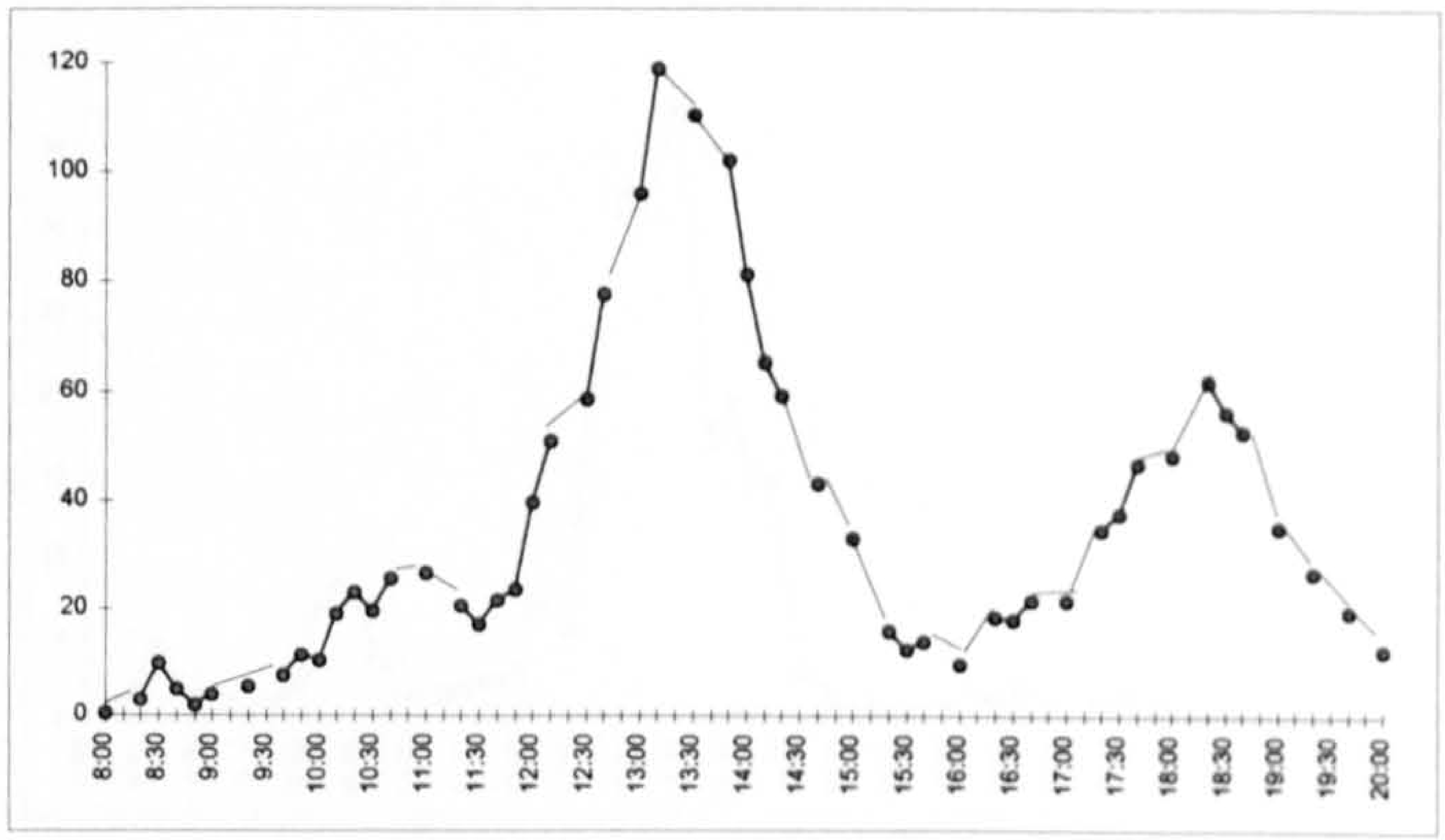


Figure 1. Mean all static

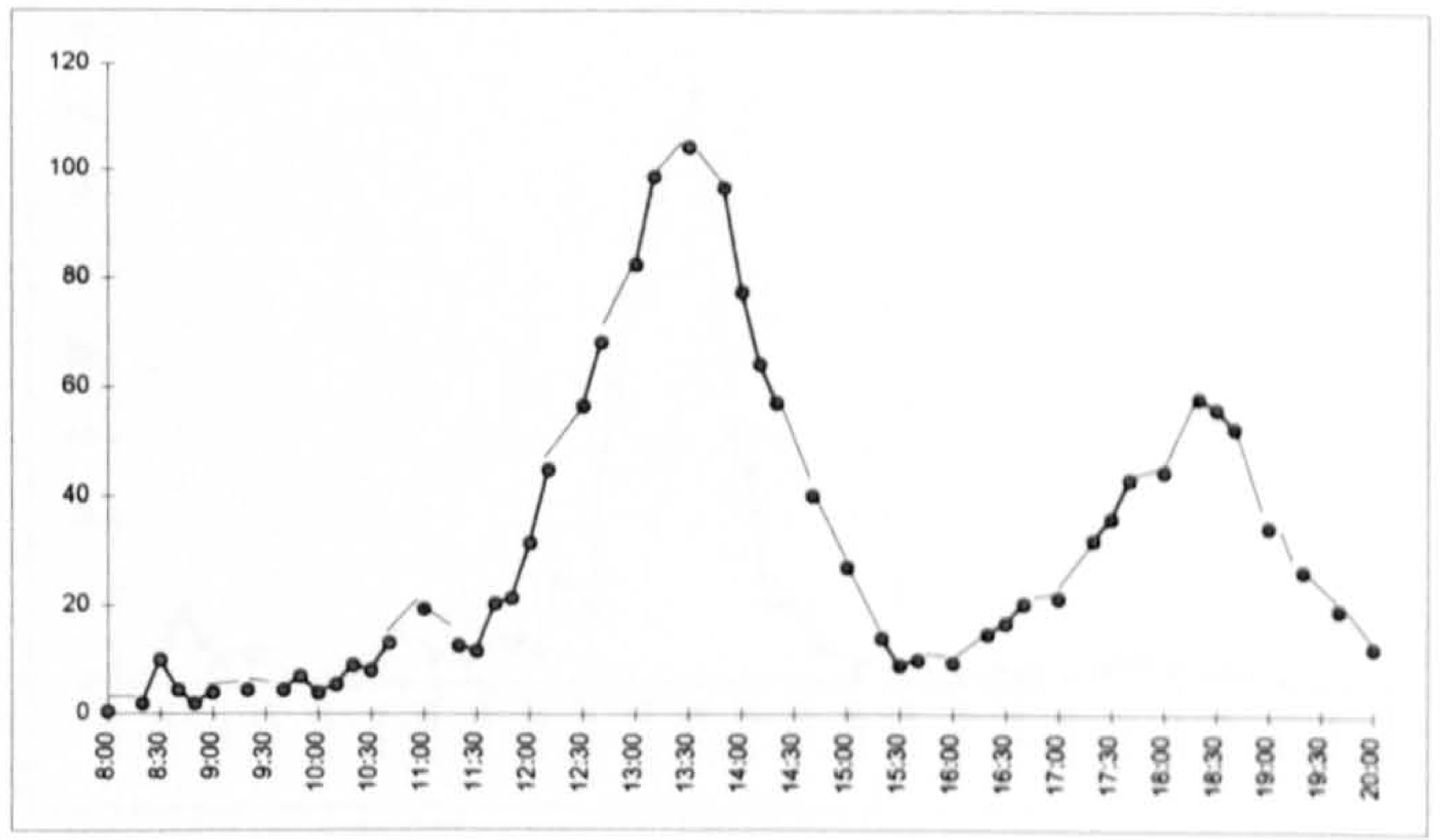


Figure 2. Mean all suits static

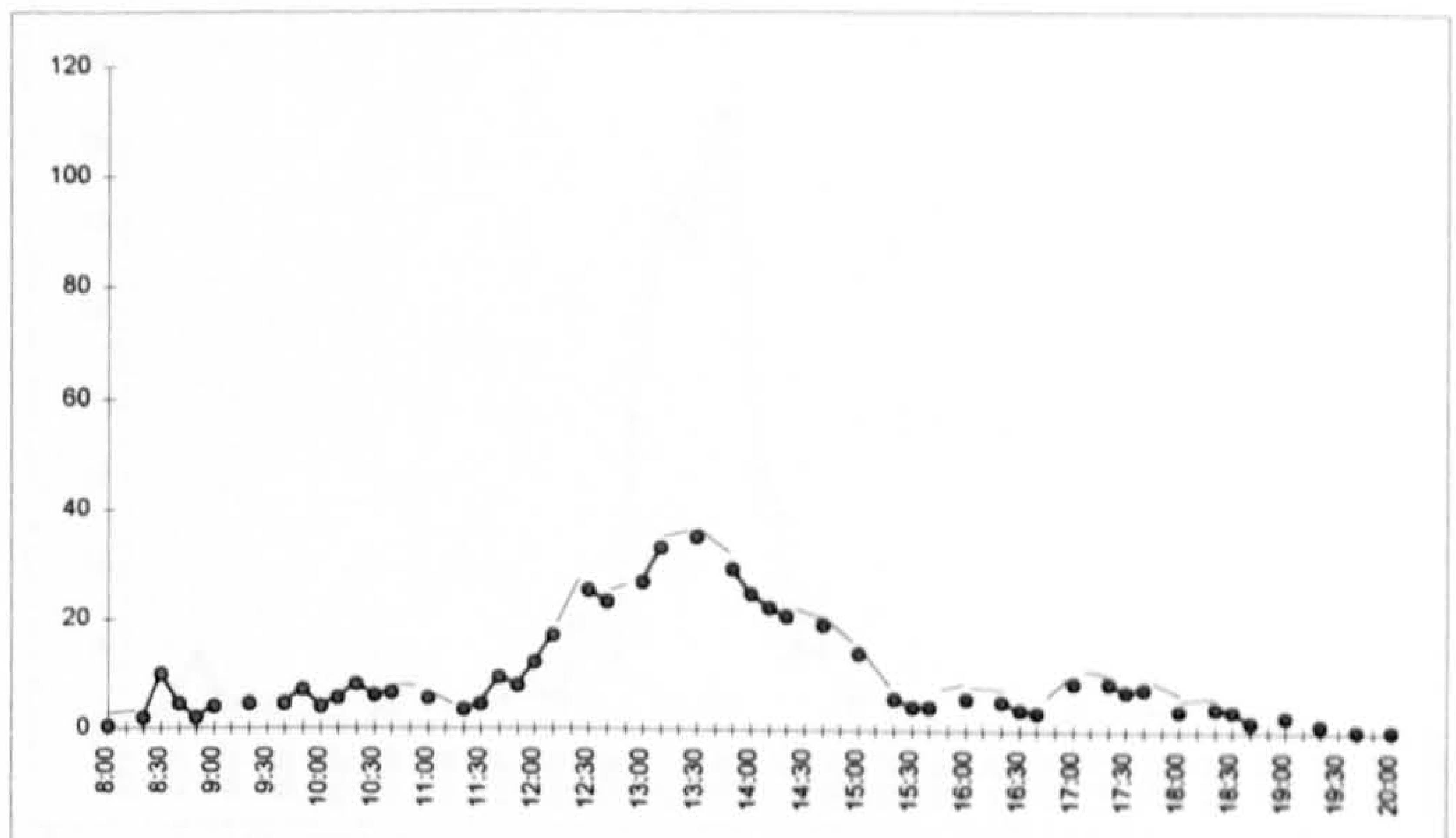


Figure 3. Mean all suits not at pubs static

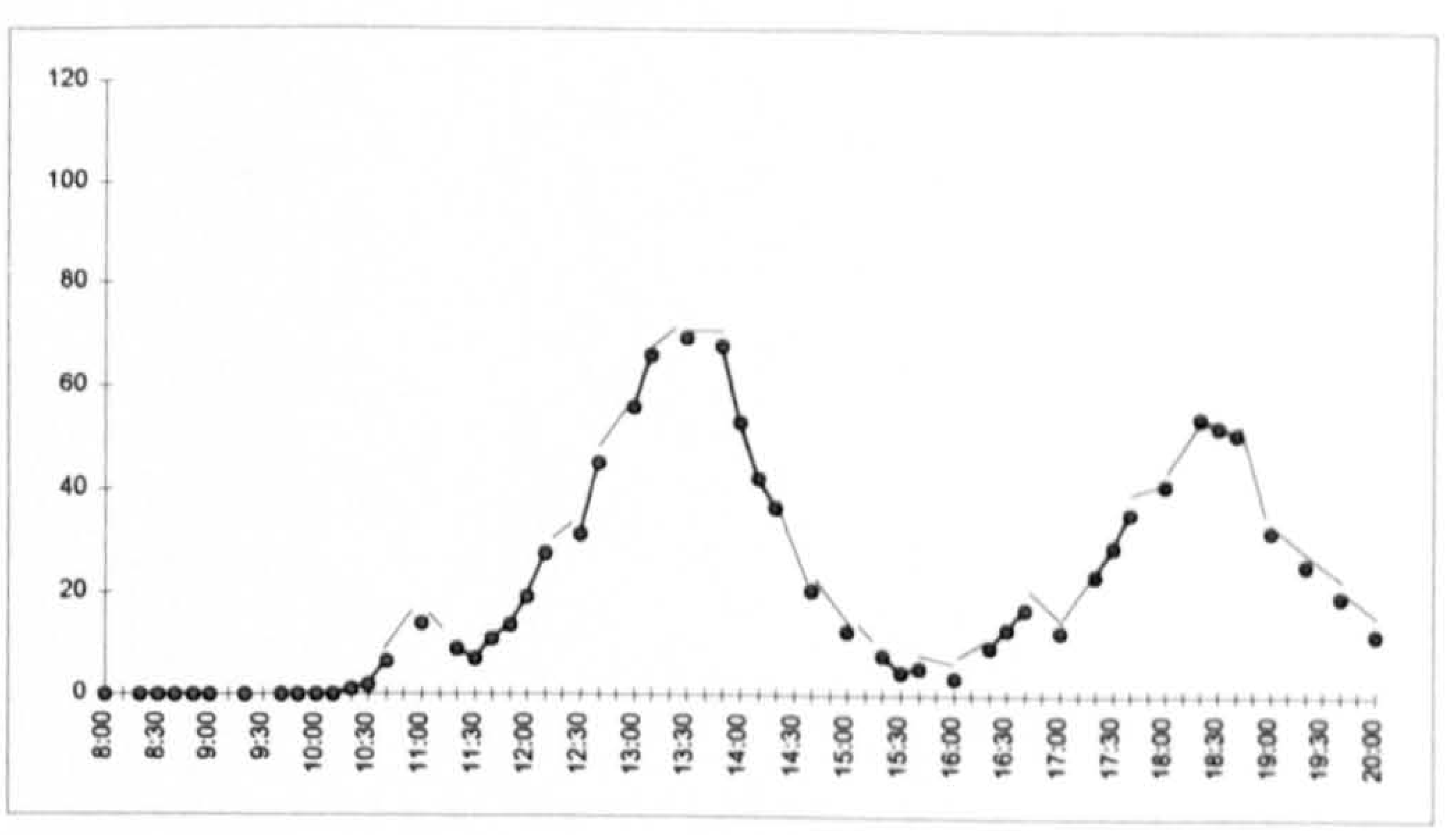


Figure 4. Mean all suits at pubs static

Plate 5.15. St. Anne St. Agnes churchyard - Levels of static people distribution throughout the day
Observation: July and August 1996

Time slot	Mean all static	Mean all suits	Mean all suits not at pubs
8:00	0.5	0.5	0.5
8:10			
8:20	1	1	1
8:30	2.5	2.5	2.5
8:40	4.5	4.5	4.5
8:50	2.5	2.5	2.5
9:00	1.5	1.5	1.5
9:10			
9:20	1.5	1.5	1.5
9:30			
9:40	1	0.5	0.5
9:50	1.5	0.5	0.5
10:00	2.5	0.5	0.5
10:10	7	0	0
10:20	8.5	1	1
10:30	7.5	1.5	1.5
10:40	4	3	3
10:50			
11:00	1.5	1.5	1.5
11:10			
11:20	1.5	1.5	1.5
11:30	2	2	2
11:40	2.5	2.5	2.5
11:50	2.5	2.5	2.5
12:00	3	2	2
12:10	7.5	6.5	6.5
12:20			
12:30	5.5	4.5	4.5
12:40	20	18.5	18.5
12:50			
13:00	32	30.5	30.5
13:10	31	29.5	29.5
13:20			
13:30	37.5	36.5	36.5
13:40			
13:50	17	15.5	15.5
14:00	19.5	13	13
14:10	15	5	5
14:20	14.5	5	5
14:30			
14:40	3	2	2
14:50			
15:00	1	1	1
15:10			
15:20	1	1	1
15:30	0	0	0
15:40	0.5	0.5	0.5
15:50			
16:00	1	0.5	0.5
16:10			
16:20	1.5	1	1
16:30	1	0.5	0.5
16:40	2	1	1
16:50			
17:00	0.5	0.5	0.5
17:10			
17:20	1	1	1
17:30	1.5	1.5	1.5
17:40	1.5	1.5	1.5
17:50			
18:00	1	1	1
18:10			
18:20	0.5	0.5	0.5
18:30	0.5	0.5	0.5
18:40	0.5	0.5	0.5
18:50			
19:00	0	0	0
19:10			
19:20	0	0	0
19:30			
19:40	0	0	0
19:50			
20:00	0	0	0

Table 1. Levels of static people throughout the day

The table gives the mean number of static people over two days
Public space without wine bar/pub

Observations carried out on 22nd July and 3rd August 1996

Mean temperature:

22nd July: 24.7 C, sunny
3rd August: 18.1 C, sunny

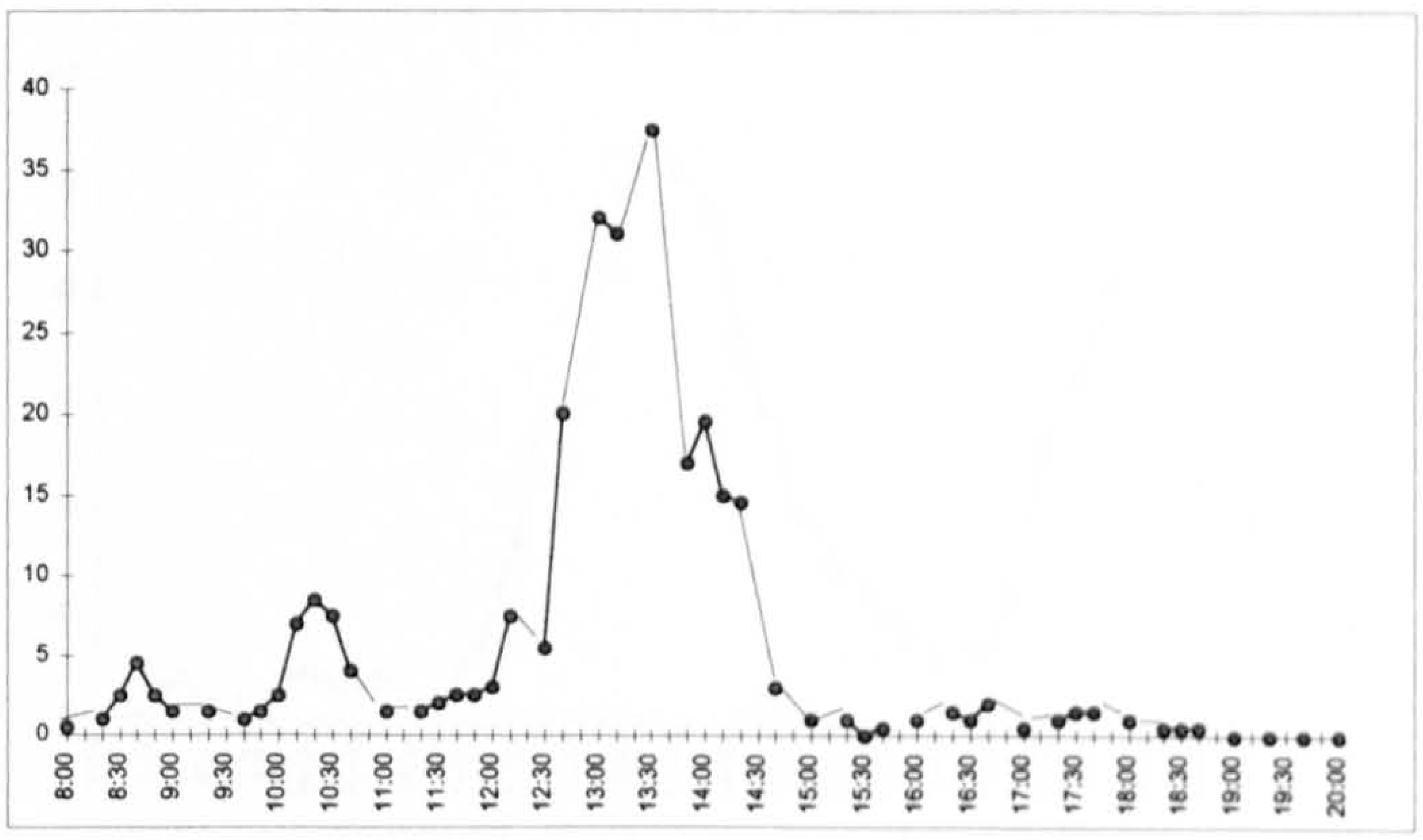


Figure 1. Mean all static

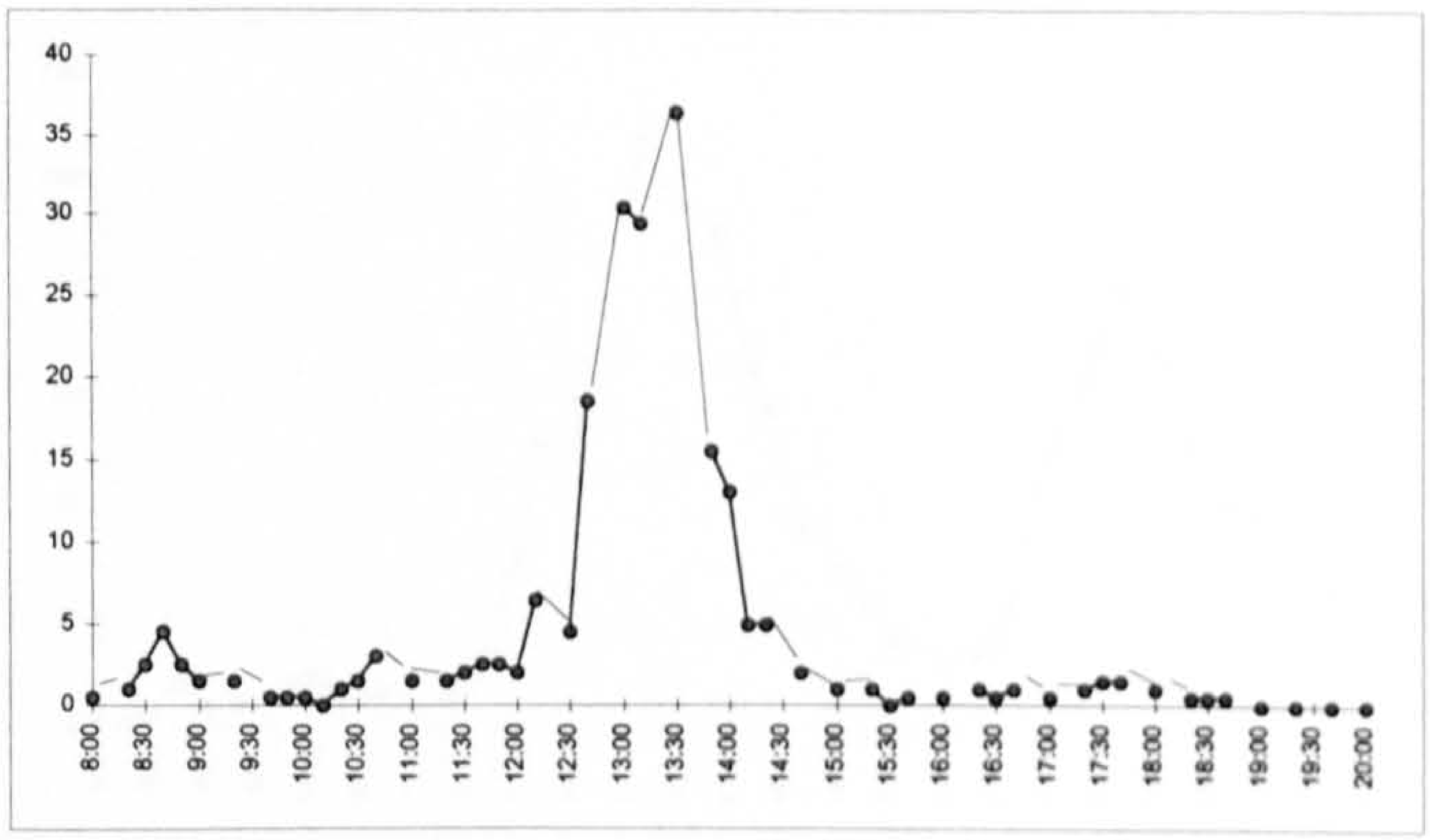


Figure 2. Mean all suits static

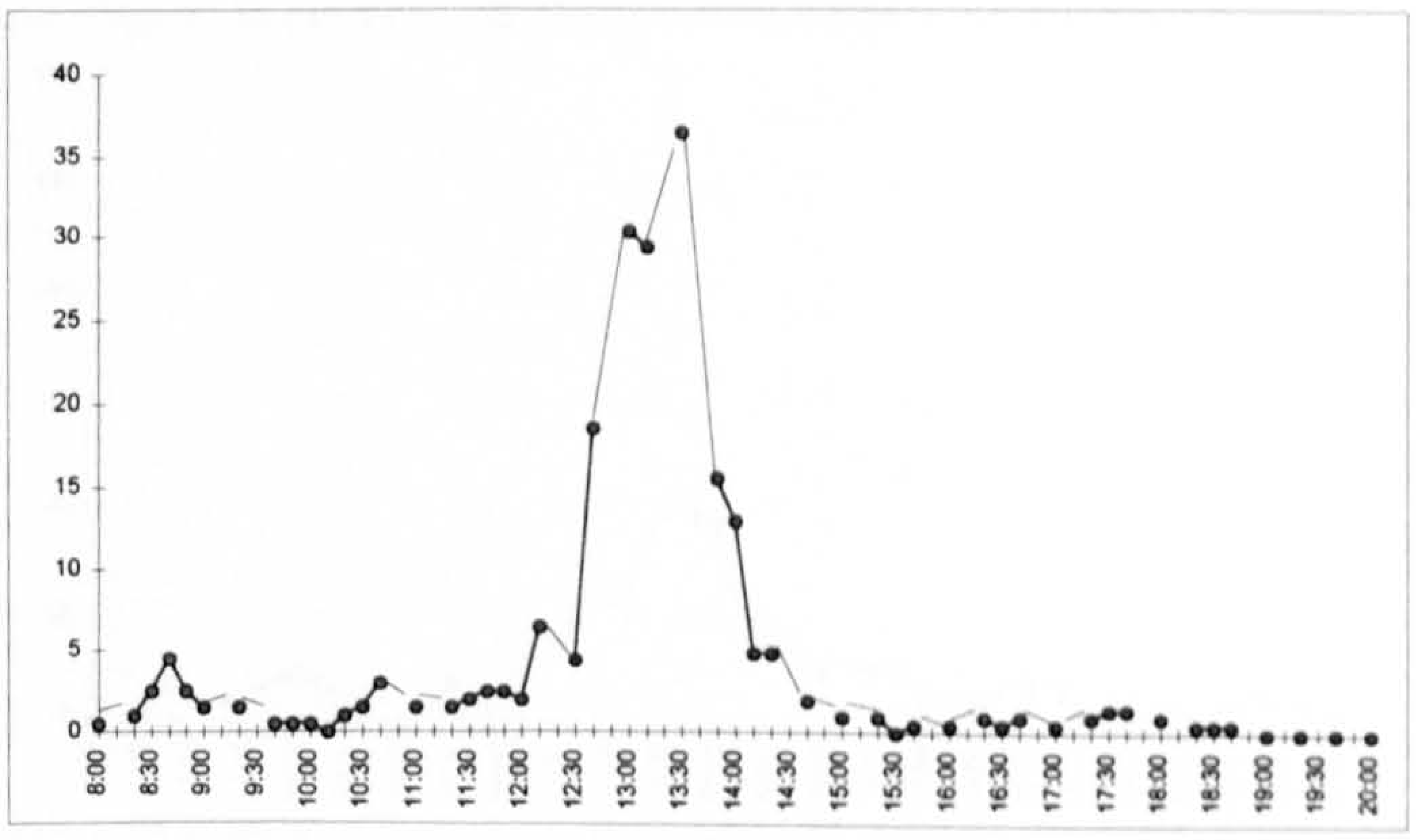


Figure 3. Mean all suits not at pubs static

Plate 5.16. Whittington Gardens - Levels of static people distribution throughout the day
Observation: July and August 1996

Time slot	Mean all static	Mean all suits	Mean all suits not at pubs	Mean all suits at pubs
8:00	0.5	0.5	0.5	0
8:10				
8:20	0.5	0.5	0.5	0
8:30	1.5	1.5	1.5	0
8:40	7	7	7	0
8:50	8	8	8	0
9:00	4	4	4	0
9:10				
9:20	4	4	4	0
9:30				
9:40	5.5	5.5	5.5	0
9:50	8	8	8	0
10:00	9.5	9	9	0
10:10	7.5	7.5	7.5	0
10:20	6	4.5	4.5	0
10:30	6.5	4.5	4.5	0
10:40	8	6	6	0
10:50				
11:00	2.5	1.5	1.5	0
11:10				
11:20	4.5	4.5	3.5	1
11:30	11.5	11.5	7.5	4
11:40	14	14	2.5	11.5
11:50	24.5	23	4	19
12:00	34	32.5	5.5	27
12:10	52.5	52.5	12	40.5
12:20				
12:30	50.5	50.5	15.5	35
12:40	68	67.5	21	46.5
12:50				
13:00	98.5	97.5	24	73.5
13:10	110	108	21.5	86.5
13:20				
13:30	101.5	96	39.5	56.5
13:40				
13:50	94	91	38.5	52.5
14:00	83.5	80	38	42
14:10	65.5	65.5	26.5	39
14:20	58	58	19.5	38.5
14:30				
14:40	38	36.5	15	21.5
14:50				
15:00	28.5	28.5	9.5	19
15:10				
15:20	23.5	21.5	11.5	10
15:30	19	16.5	10.5	6
15:40	16.5	14.5	11	3.5
15:50				
16:00	11.5	11.5	4.5	7
16:10				
16:20	13.5	13.5	6	7.5
16:30	15	15	4	11
16:40	24.5	24.5	6	18.5
16:50				
17:00	50.5	50.5	7.5	43
17:10				
17:20	64	64	6	58
17:30	72	72	2.5	69.5
17:40	81.5	81.5	2.5	79
17:50				
18:00	68.5	68.5	5.5	63
18:10				
18:20	51.5	51.5	3	48.5
18:30	44	44	3	41
18:40	40.5	40.5	1	39.5
18:50				
19:00	38.5	38.5	4.5	34
19:10				
19:20	28	28	5	23
19:30				
19:40	25.5	25.5	4	21.5
19:50				
20:00	19	19	2.5	16.5

Table 1. Levels of static people throughout the day

The table gives the mean number of static people over two days
Public space with wine bar/pub

Observations carried out on 26th July and 1st August 1996

Mean temperature:

26th July: 21.7 C, sunny
1st August: 17.9 C, cloudy

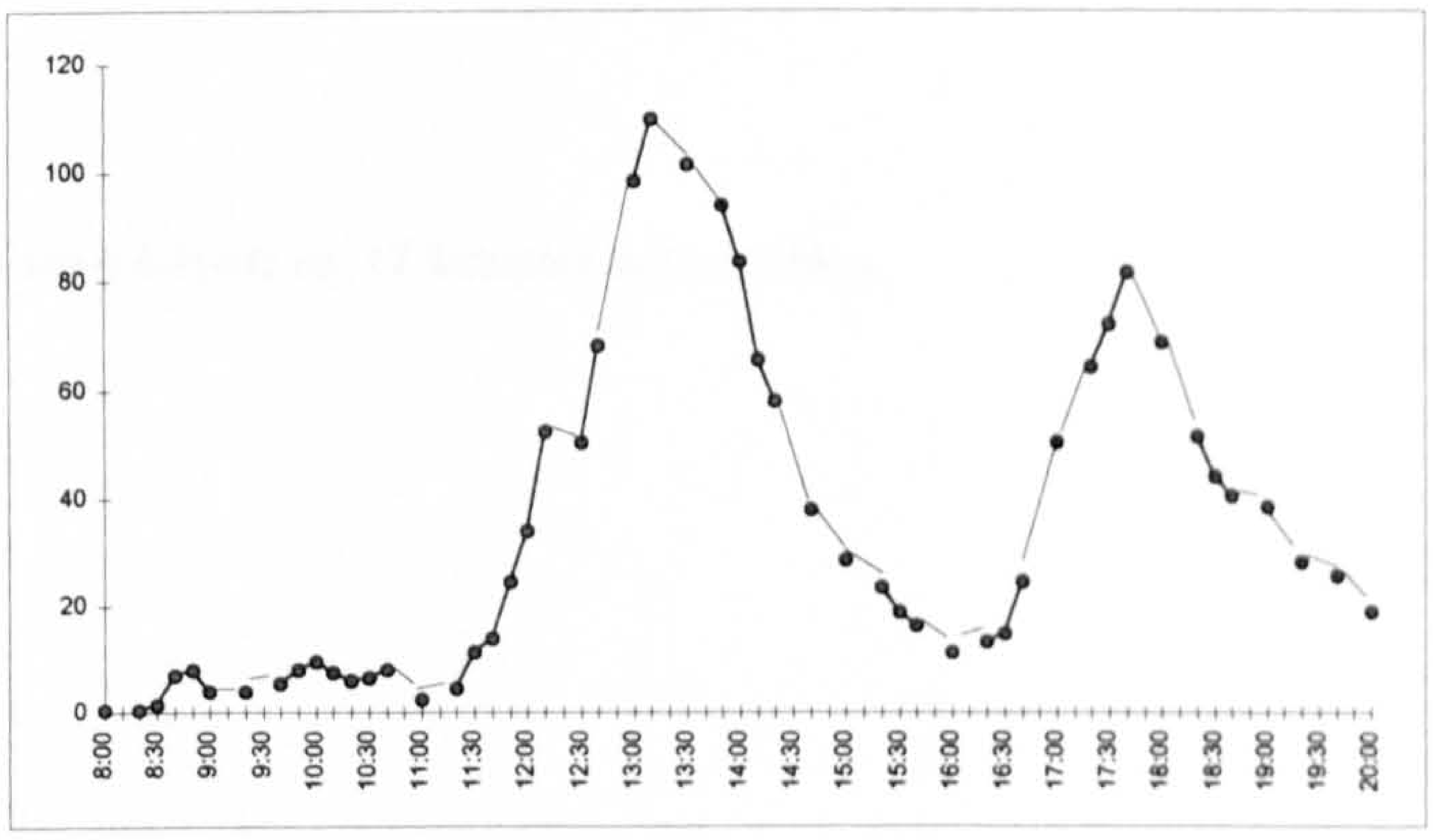


Figure 1. Mean all static

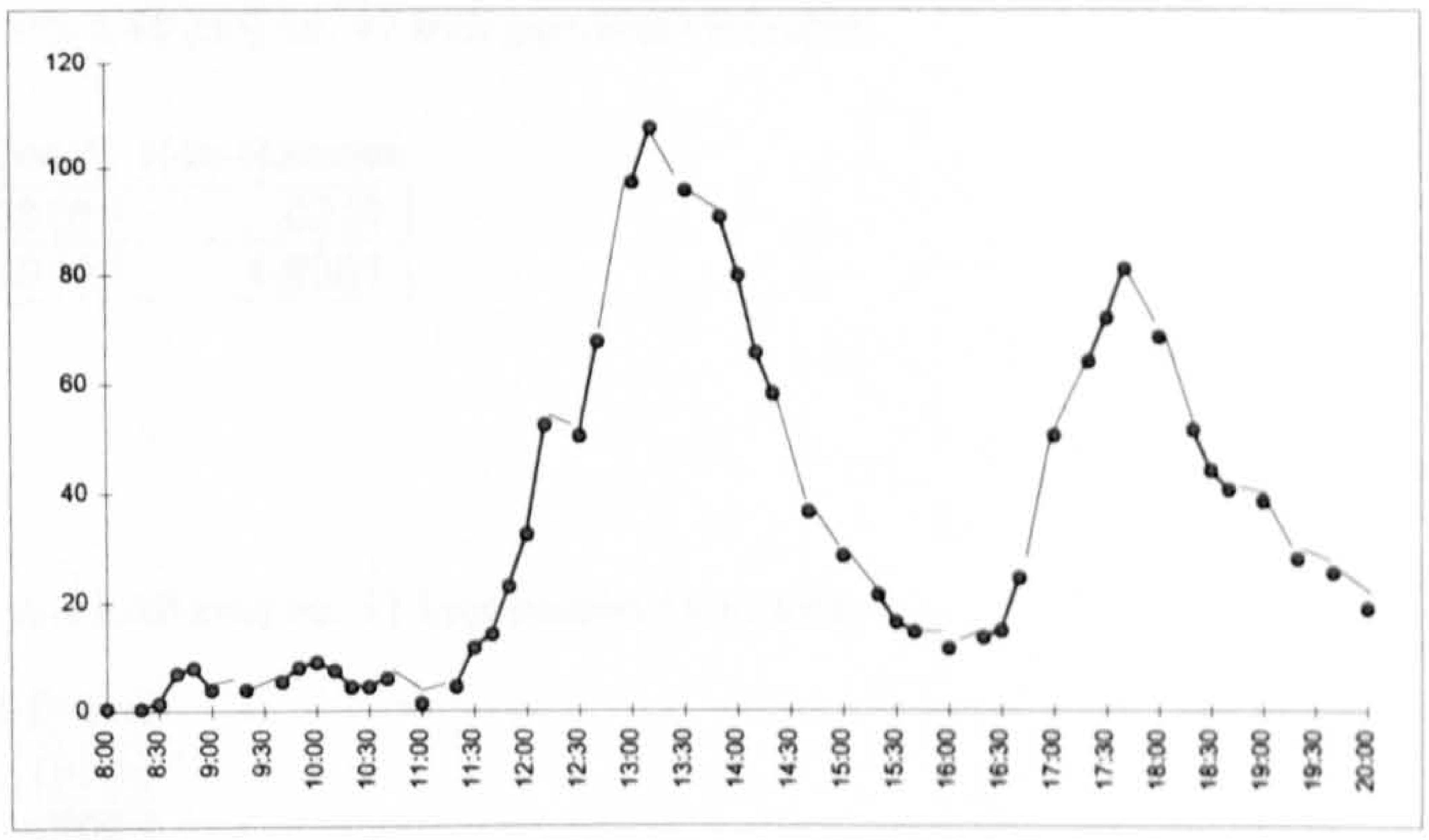


Figure 2. Mean all suits static

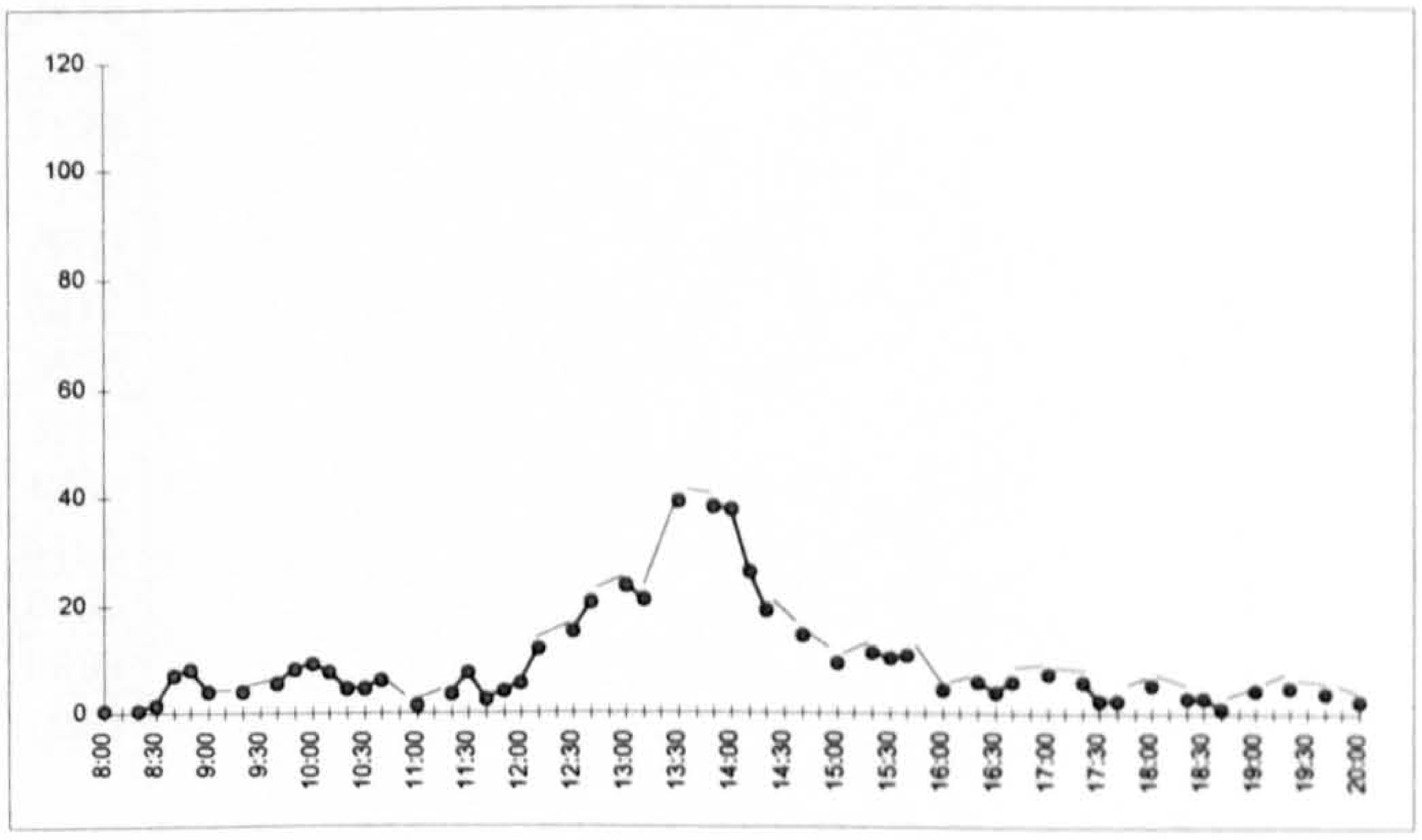


Figure 3. Mean all suits not at pubs static

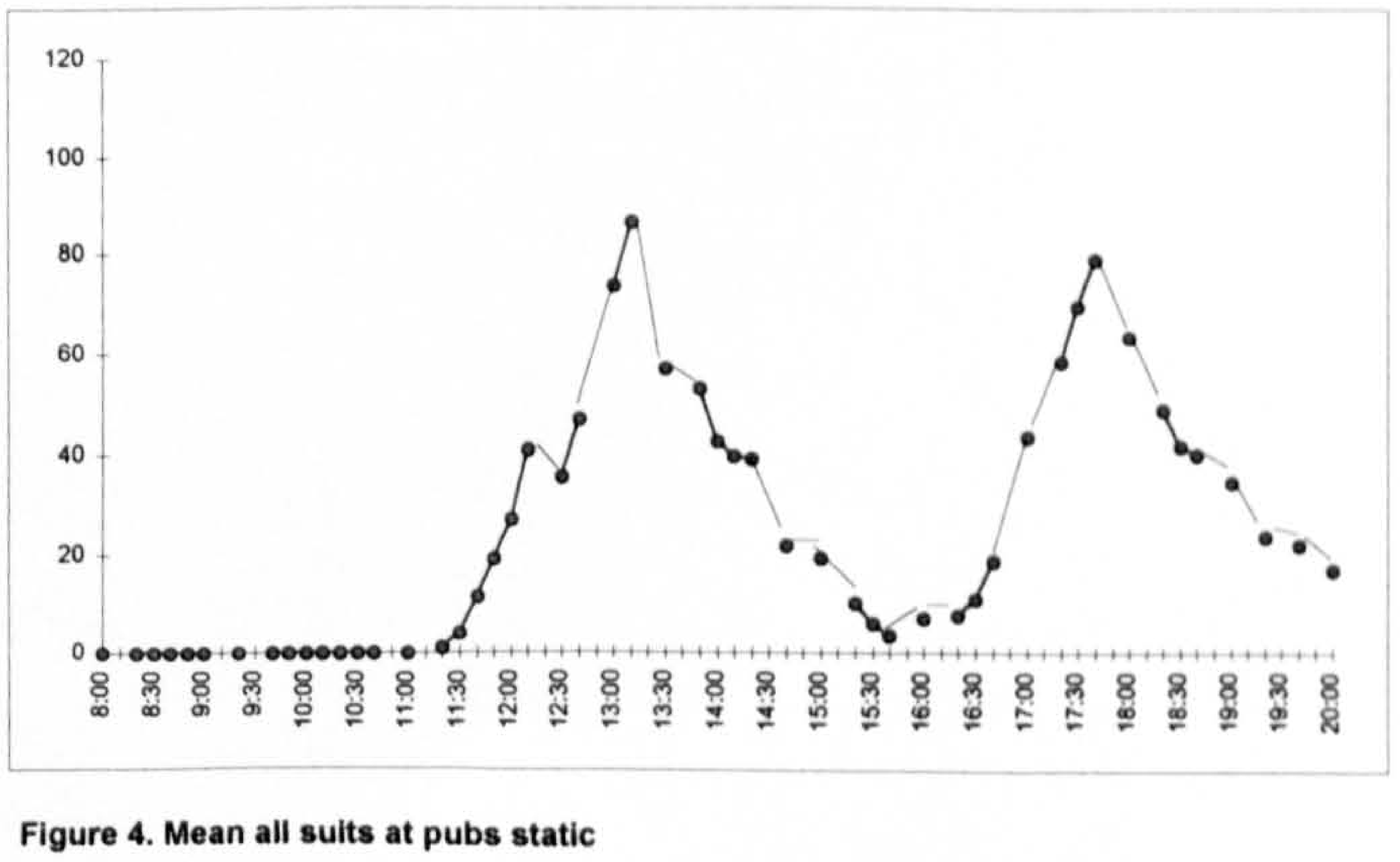


Figure 4. Mean all suits at pubs static

Plate 5.18. Levels of pedestrian movement - stepwise regression analysis summary results

Stepwise regression summary

mean nº moving people inside public space (8 am-4:40 pm) vs. 17 independent variables

F-to-Enter	4.0000
F-to-Remove	3.9960
Number of Steps	1
Variables Entered	1
Variables Forced	0
Stepwise Procedure	Forward

Stepwise regression summary
Variables in model

mean nº moving people inside public space (8 am-4:40 pm) vs. 17 independent variables
step: 1

	Coefficient	Std. Error	Std. Coeff.	F-to-Remove
Intercept	-19.9818	128.1504	-19.9818	.0243
strategic value	66.8438	30.1782	.5940	4.9061

Stepwise regression summary
Variables not in model

mean nº moving people inside public space (8 am-4:40 pm) vs. 17 independent variables
step: 1

	Partial Cor.	F-to-Enter
public space area (m2)	.1546	.1958
isovist area (m2)	-.2742	.6502
visibility ratio	-.3160	.8877
enclosure ratio	.3673	1.2476
sum isov length (total)	-.1655	.2253
mean isov length (total)	-.3037	.8128
sum isov length (selc)	-.1169	.1109
mean isov length (selc)	-.3007	.7956
sum isov length (spec)	-.0520	.0217
mean isov length (spec)	-.2085	.3636
sum length axial lines	-.1947	.3151
mean length ax.lines	-.2256	.4290
local strategic value	-.0491	.0193
sum Rn values (T) ax. lines	.0780	.0490
Rn value main line	-.3170	.8938
Rn value public space R	-.2854	.7093

Plate 5.19. Levels of static occupancy - stepwise regression analysis summary results

Stepwise regression summary

mean number static people suits category (8 am-4:40 pm) vs. 17 independent variables

F-to-Enter	4.0000
F-to-Remove	3.9960
Number of Steps	1
Variables Entered	1
Variables Forced	0
Stepwise Procedure	Forward

Stepwise regression summary
Variables in model

mean number static people suits category (8 am-4:40 pm) vs. 17 independent variables
step: 1

	Coefficient	Std. Error	Std. Coeff.	F-to-Remove
Intercept	-8.7323	5.0672	-8.7323	2.9698
local strategic value	2.6890	.4406	.8975	37.2528

Stepwise regression summary
Variables not in model

mean number static people suits category (8 am-4:40 pm) vs. 17 independent variables
step: 1

	Partial Cor.	F-to-Enter
public space area (m2)	.3595	1.1877
isovist area (m2)	-.0101	.0008
visibility ratio	-.0255	.0052
enclosure ratio	.0959	.0743
sum isov length (total)	.0835	.0561
mean isov length (total)	.0594	.0283
sum isov length (selc)	.1681	.2326
mean isov length (selc)	-.0342	.0094
sum isov length (spec)	.1453	.1725
mean isov length (spec)	-.0626	.0315
sum length axial lines	-.0431	.0149
mean length ax.lines	-.4528	2.0631
strategic value	-.0628	.0317
sum Rn values (T) ax. lines	-.1703	.2389
Rn value main line	-.3697	1.2665
Rn value public space R	-.4622	2.1738

Table 5.1: City of London: number of moving people according to gates (1/3)

Data presented for the mean hourly rates including male and female people

Public space name	Gate number	Gate type	8-9:20 am	9:40-11:50 am	12-2:10 pm	2:20-4:40 pm	4:50-6:10 pm	6:20-8 pm	All day
Abchurchyard	1.01	street	1704	528	1608	1068	1512	720	1190
Abchurchyard	1.02	street	72	48	144	36	108	24	72
Abchurchyard	1.03	street	120	60	48	48	48	24	58
Abchurchyard	1.04	entrance public space	120	84	48	48	48	24	62
Abchurchyard	1.05	inside public space	120	60	24	48	48	24	54
Abchurchyard	1.06	entrance public space	120	120	132	60	108	120	110
Abchurchyard	1.07	street	960	288	576	264	720	96	484
Abchurchyard	1.08	street	744	168	420	192	624	120	378
Abchurchyard	1.09	street	48	72	144	48	72	0	64
Abchurchyard	1.10	street	288	108	312	72	264	72	186
Abchurchyard	1.11	street	5664	864	2904	912	4692	504	2590
Abchurchyard	1.12	street	624	240	540	276	948	264	482
Abchurchyard	1.13	street	1632	384	1152	504	2892	816	1230
Bank Corner	2.01	entrance public space	1824	408	612	468	1260	936	918
Bank Corner	2.02	inside public space	1632	300	456	372	1200	336	716
Bank Corner	2.03	entrance public space	1968	432	612	504	1572	720	968
Bank Corner	2.04	entrance public space	768	84	192	108	876	360	398
Bank Corner	2.05	entrance public space	744	264	348	180	552	480	428
Bank Corner	2.06	inside public space	96	84	72	36	120	24	72
Bank Corner	2.07	inside public space	0	0	0	0	36	0	6
Bank Corner	2.08	entrance public space	72	60	12	60	108	0	52
Bank Corner	2.09	entrance public space	0	12	0	0	48	24	14
Bank Corner	2.10	entrance public space	0	12	48	0	36	24	20
Bank Corner	2.11	street	1488	156	240	204	2316	120	754
Bank Corner	2.12	street	1128	312	1452	480	1152	264	798
Bank Corner	2.13	street	4248	636	1248	972	2304	1128	1756
Bank Corner	2.14	street	3648	516	1536	636	1848	696	1480
Bank Corner	2.15	street	192	24	36	36	264	0	92
Bank Corner	2.16	street	3312	672	1932	972	3456	648	1832
Bank Corner	2.17	street	1752	144	240	156	612	240	524
Bank Corner	2.18	street	3816	1104	3636	1476	4116	1128	2546
Bank Corner	2.19	street	6552	1092	1776	1332	4752	840	2724
Exchange Sq.	3.01	street	384	168	324	204	288	168	256
Exchange Sq.	3.02	street	120	132	96	12	0	0	60
Exchange Sq.	3.03	street	600	168	780	240	600	504	482
Exchange Sq.	3.04	street	48	48	240	132	96	120	114
Exchange Sq.	3.05	street	72	24	48	72	120	24	60
Exchange Sq.	3.06	street	768	348	2136	468	1200	840	960
Exchange Sq.	3.07	street	120	84	120	60	60	120	94
Exchange Sq.	3.08	street	912	528	1872	432	1332	552	938
Exchange Sq.	3.09	entrance public space	888	276	1596	312	960	552	764
Exchange Sq.	3.10	street	1416	336	1704	468	1992	576	1082
Exchange Sq.	3.11	street	504	84	276	252	1224	216	426
Exchange Sq.	3.12	entrance public space	912	252	1428	216	744	360	652
Exchange Sq.	3.13	inside public space	816	204	2340	564	3768	648	1390
Exchange Sq.	3.14	entrance public space	48	0	360	72	24	24	88
Exchange Sq.	3.15	buildings	360	144	372	108	24	0	168
Exchange Sq.	3.16	buildings	456	144	312	192	72	72	208
Exchange Sq.	3.17	entrance public space	288	96	288	216	48	144	180
Exchange Sq.	3.18	inside public space	72	96	1296	396	336	288	414
Exchange Sq.	3.19	inside public space	384	180	2148	360	504	216	632
Exchange Sq.	3.20	inside public space	24	48	204	120	120	24	90
Exchange Sq.	3.21	inside public space	192	120	1044	228	288	144	336
Exchange Sq.	3.22	entrance public space	192	24	216	48	48	48	96
Exchange Sq.	3.23	entrance public space	288	156	516	288	228	120	266
Exchange Sq.	3.24	entrance public space	648	408	1464	456	648	336	660
Exchange Sq.	3.25	street	648	180	564	228	780	528	488
Exchange Sq.	3.26	street	768	300	888	336	600	312	534
Exchange Sq.	3.27	street	1344	300	1560	480	1560	216	910
Exchange Sq.	3.28	street	720	324	1452	444	1872	600	902

Table 5.1: City of London: number of moving people according to gates (2/3)

Data presented for the mean hourly rates including male and female people

Public space name	Gate number	Gate type	8-9:20 am	9:40-11:50 am	12-2:10 pm	2:20-4:40 pm	4:50-6:10 pm	6:20-8 pm	All day
Fenchurch Pl.	4.01	street	864	300	852	504	1008	240	628
Fenchurch Pl.	4.02	street	1992	1260	3948	1584	2508	648	1990
Fenchurch Pl.	4.03	street	1800	804	1644	984	2196	552	1330
Fenchurch Pl.	4.04	street	240	312	1176	984	1056	456	704
Fenchurch Pl.	4.05	street	792	276	648	576	2148	336	796
Fenchurch Pl.	4.06	street	1056	300	960	648	984	312	710
Fenchurch Pl.	4.07	street	960	348	588	552	828	48	554
Fenchurch Pl.	4.08	street	984	864	2172	672	948	216	976
Fenchurch Pl.	4.09	street	3384	444	1044	816	1728	168	1264
Fenchurch Pl.	4.10	street	1368	432	1008	768	2424	288	1048
Fenchurch Pl.	4.11	street	2208	624	1272	540	1368	432	1074
Fenchurch Pl.	4.12	buildings	5112	660	852	1008	4584	768	2164
Fenchurch Pl.	4.13	inside public space	2592	78	222	462	2328	432	1019
Fenchurch Pl.	4.14	inside public space	192	222	588	204	432	24	277
Fenchurch Pl.	4.15	street	984	300	828	432	1128	360	672
Fenchurch Pl.	4.16	street	816	132	360	108	372	144	322
Fenchurch Pl.	4.17	inside public space	72	48	312	168	204	72	146
Finsbury Av.	5.01	street	2856	1320	3516	1692	2556	1728	2278
Finsbury Av.	5.02	street	288	180	612	132	540	192	324
Finsbury Av.	5.03	street	1224	420	1092	504	1152	408	800
Finsbury Av.	5.04	street	504	348	756	396	936	168	518
Finsbury Av.	5.05	street	1248	300	1056	468	912	48	672
Finsbury Av.	5.06	street	768	348	2136	468	1200	840	960
Finsbury Av.	5.07	street	120	84	120	60	60	120	94
Finsbury Av.	5.08	street	912	528	1872	432	1332	552	938
Finsbury Av.	5.09	entrance public space	1248	648	1524	624	1464	648	1026
Finsbury Av.	5.10	inside public space	2520	660	2292	852	2352	1032	1618
Finsbury Av.	5.11	entrance public space	1248	540	1524	948	1128	600	998
Finsbury Av.	5.12	entrance public space	1344	432	1380	696	1380	1152	1064
Finsbury Av.	5.13	inside public space	744	312	1140	336	660	192	564
Finsbury Av.	5.14	entrance public space	768	156	792	468	540	168	482
Finsbury Av.	5.15	inside public space	648	216	708	408	444	240	444
Finsbury Av.	5.16	inside public space	1824	300	1656	288	1416	96	930
Finsbury Av.	5.17	inside public space	360	84	348	120	108	72	182
Finsbury Av.	5.18	inside public space	72	12	12	12	60	96	44
Finsbury Av.	5.19	entrance public space	1896	540	1596	552	1416	504	1084
Finsbury Av.	5.20	street	1392	444	1224	588	1440	168	876
Finsbury Av.	5.21	buildings	192	60	252	144	228	0	146
Fleet Place	3.01	street	624	456	900	336	684	888	648
Fleet Place	3.02	street	384	300	432	156	816	432	420
Fleet Place	3.03	buildings	1464	180	72	72	588	168	424
Fleet Place	6.04	buildings	48	0	24	60	120	24	46
Fleet Place	6.05	street	48	12	24	12	0	0	16
Fleet Place	6.06	street	96	24	84	0	180	48	72
Fleet Place	6.07	entrance public space	168	24	96	72	288	168	136
Fleet Place	6.08	inside public space	408	96	708	144	336	456	358
Fleet Place	6.09	street	48	24	120	60	60	24	56
Fleet Place	6.10	street	0	0	36	36	36	0	18
Fleet Place	6.11	entrance public space	168	144	228	96	180	216	172
Fleet Place	6.12	street	144	36	300	60	168	24	122
Fleet Place	6.13	street	192	204	540	192	240	96	244
Fleet Place	6.14	street	1080	168	1308	540	708	240	674
Fleet Place	6.15	street	48	252	48	12	24	0	64
Fleet Place	6.16	street	864	192	1044	96	936	288	570
Fleet Place	6.17	street	1488	948	2820	1080	2784	744	1644
Fleet Place	6.18	street	1512	240	1308	612	1224	456	892
Fleet Place	6.19	entrance public space	144	48	348	36	36	96	118
Fleet Place	6.20	buildings	216	72	252	72	216	96	154
Fleet Place	6.21	buildings	360	144	504	180	600	120	318
Fleet Place	6.22	inside public space	60	48	216	48	108	24	84
Fleet Place	6.23	entrance public space	120	48	312	72	156	24	122
Love Lane	7.01	entrance public space	48	60	48	24	48	24	42
Love Lane	7.02	inside public space	24	12	12	24	0	0	12
Love Lane	7.03	entrance public space	216	36	84	24	72	72	84
Love Lane	7.04	inside public space	216	36	72	24	72	72	82
Love Lane	7.05	entrance public space	192	36	132	12	96	72	90
Love Lane	7.06	inside public space	48	60	12	24	36	24	34
Love Lane	7.07	street	1104	192	720	228	852	144	540
Love Lane	7.08	street	408	84	240	96	180	72	180
Love Lane	7.09	street	336	120	408	300	372	96	272
Love Lane	7.10	street	504	216	444	300	396	240	350

Table 5.1: City of London: number of moving people according to gates (3/3)

Data presented for the mean hourly rates including male and female people

Public space name	Gate number	Gate type	8-9:20 am	9:40-11:50 am	12-2:10 pm	2:20-4:40 pm	4:50-6:10 pm	6:20-8 pm	All day
New Change	8.01	entrance public space	48	24	84	0	24	264	74
New Change	8.02	entrance public space	48	24	108	24	24	336	94
New Change	8.03	inside public space	48	24	48	0	0	216	56
New Change	8.04	street	192	204	444	132	168	168	218
New Change	8.05	street	408	372	840	444	780	504	558
New Change	8.06	street	3720	1224	4212	1584	2784	1224	2458
New Change	8.07	street	2304	1020	2604	1464	3096	960	1908
New Change	8.08	street	312	144	696	228	264	48	282
New Change	8.09	pavement	1200	228	1260	672	792	744	816
New Change	8.10	pavement	336	120	288	144	156	192	206
North Guildhall	9.01	street	408	204	384	168	288	48	250
North Guildhall	9.02	street	648	396	612	300	636	264	476
North Guildhall	9.03	street	960	636	792	360	972	528	708
North Guildhall	9.04	street	480	144	360	228	468	192	312
North Guildhall	9.05	entrance public space	576	396	540	216	540	264	422
North Guildhall	9.06	inside public space	288	96	312	96	144	72	168
North Guildhall	9.07	inside public space	552	432	456	324	828	288	480
North Guildhall	9.08	entrance public space	792	240	348	180	696	240	416
North Guildhall	9.09	street	336	120	408	300	372	96	272
Royal Exchange	10.01	entrance public space	1416	528	1500	528	1848	264	1014
Royal Exchange	10.02	inside public space	1560	672	1608	516	1620	216	1032
Royal Exchange	10.03	entrance public space	2352	492	1344	492	1716	360	1126
Royal Exchange	10.04	street	3408	348	1164	792	3000	936	1608
Royal Exchange	10.05	street	1488	384	696	552	1512	480	852
Royal Exchange	10.06	street	672	108	228	240	636	312	366
Royal Exchange	10.07	inside public space	96	36	60	60	120	0	62
Royal Exchange	10.08	street	2400	660	1836	804	1836	312	1308
Royal Exchange	10.09	street	264	264	804	360	1092	240	504
Royal Exchange	10.10	street	0	24	48	0	12	0	14
Royal Exchange	10.11	street	3264	432	1776	744	3012	456	1614
Royal Exchange	10.12	street	120	72	120	108	240	120	130
Royal Exchange	10.13	street	3456	936	1836	780	2052	1344	1734
Royal Exchange	10.14	street	3648	516	1536	636	1848	696	1480
Royal Exchange	10.15	street	192	24	36	36	264	0	92
St. Anne	11.01	street	120	84	72	48	132	24	80
St. Anne	11.02	street	240	72	432	60	156	48	168
St. Anne	11.03	street	72	36	84	36	252	24	84
St. Anne	11.04	entrance public space	72	0	24	0	0	0	16
St. Anne	11.05	inside public space	72	0	12	0	0	0	14
St. Anne	11.06	entrance public space	72	24	48	0	12	0	26
St. Anne	11.07	entrance public space	24	36	36	0	0	0	16
St. Anne	11.08	inside public space	0	36	12	24	0	24	16
St. Anne	11.09	entrance public space	0	12	48	24	0	24	18
St. Anne	11.10	inside public space	0	0	24	0	0	0	4
St. Anne	11.11	street	768	360	948	288	660	216	540
St. Anne	11.12	street	336	48	276	120	432	24	206
St. Anne	11.13	street	2280	564	2136	528	1668	864	1340
St. Anne	11.14	street	312	144	696	228	264	48	282
St. Anne	11.15	street	432	84	240	96	276	48	196
Whittington Gs.	12.01	street	2136	912	3096	1236	3612	768	1960
Whittington Gs.	12.02	street	1056	192	564	156	576	144	448
Whittington Gs.	12.03	street	2688	936	2616	864	2808	984	1816
Whittington Gs.	12.04	street	744	312	804	228	864	120	512
Whittington Gs.	12.05	street	840	156	408	120	768	72	394
Whittington Gs.	12.06	street	1056	408	1044	408	1512	432	810
Whittington Gs.	12.07	street	984	420	1164	600	1224	456	808
Whittington Gs.	12.08	street	120	192	276	96	108	72	144
Whittington Gs.	12.09	street	216	288	456	204	240	96	250
Whittington Gs.	12.10	entrance public space	240	156	684	72	144	144	240
Whittington Gs.	12.11	entrance public space	216	48	396	24	108	96	148
Whittington Gs.	12.12	inside public space	72	36	132	24	24	0	48
Whittington Gs.	12.13	inside public space	216	84	480	48	108	72	168

Table 5.2: Moving people and syntactic variables data

Variable	Abchur-chyard	Bank Corner	Exchang Square	Fenchur Place	Finsbu-ry Av.	Fleet Place
Origin	church-yard	building develop.	office complex	building develop.	building develop.	office complex
Pubs or wine bars	yes	no	yes	yes	yes	yes
Mean all moving inside space 8–9:20 am	120.00	576.00	297.60	952.00	1028.00	234.00
Mean all moving inside space 9–11:50 am	60.00	128.00	129.60	116.00	264.00	72.00
Mean all moving inside space 12-2:10 pm	24.00	176.00	1406.40	374.00	1026.00	462.00
Mean all moving inside space 2:20-4:40 pm	48.00	136.00	333.60	278.00	336.00	96.00
Mean all moving inside space 4:40-6:10 pm	48.00	452.00	1003.20	988.00	840.00	222.00
Mean all moving inside space 6:20-8 pm	24.00	120.00	264.00	176.00	288.00	240.00
Mean all moving inside space all day	54.00	264.67	572.40	480.67	630.33	221.00
Mean all moving outside space all day	673.40	1389.56	521.86	928.31	828.89	418.46
Ratio moving outside/inside all day	12.47	5.25	0.91	1.93	1.32	1.89
Public space area (m2)	322.99	1019.85	6371.41	830.98	2957.79	1493.24
Isovist area (m2)	1024.66	17951.07	8114.85	3595.39	14331.85	7459.59
Visibility ratio	3.17	17.60	1.27	4.33	4.85	5.00
Enclosure ratio	2.82	0.59	3.37	0.22	3.34	2.82
Sum isovist length total (m)	197.63	1378.66	867.95	331.59	1383.77	562.94
Mean isovist length selected (m)	65.88	137.87	96.44	66.32	172.97	93.82
Sum isovist length special (m)	197.63	978.49	770.59	280.01	1051.58	541.73
Mean isovist length total (m)	65.88	244.62	96.32	70.00	175.26	108.35
Sum isovist length selected (m)	197.63	916.11	697.99	280.01	1051.58	541.73
Mean isovist length special (m)	65.88	305.37	99.71	70.00	175.26	108.35
Sum of the length of axial lines (m)	51.26	441.80	1403.52	427.16	1078.88	720.07
Mean sum of the length of axial lines (m)	51.26	147.27	200.5	142.39	179.81	180.02
Sum number of axial lines	1.00	3.00	7.00	3.00	6.00	4.00
Rn main line	1.28	1.49	1.24	1.26	1.28	1.39
Global integration values of T lines	1.28	4.34	1.15	2.43	•	2.65
Strategic value	1.27	4.34	8.26	3.69	7.23	5.34
Local strategic value	1.48	12.13	23.22	9.86	19.49	13.81
Rn public space	1.13	1.30	1.12	1.17	1.14	1.26

Variable	Love Lane Corner	New Change	North Guild-hall	Royal Exchan-ge	St. Anne St. Agnes	Whitting ton Gardens
Origin	Church-yard	building develop.	building develop.	building develop.	church-yard	building develop.
Pubs or wine bars	no	yes	no	yes	no	yes
Mean all moving inside space 8–9:20 am	96.00	48.00	420.00	828.00	24.00	144.00
Mean all moving inside space 9–11:50 am	36.00	24.00	264.00	354.00	12.00	60.00
Mean all moving inside space 12-2:10 pm	32.00	48.00	384.00	834.00	16.00	306.00
Mean all moving inside space 2:20-4:40 pm	24.00	0.00	210.00	288.00	8.00	36.00
Mean all moving inside space 4:40-6:10 pm	36.00	0.00	486.00	870.00	0.00	66.00
Mean all moving inside space 6:20-8 pm	32.00	216.00	180.00	108.00	8.00	36.00
Mean all moving inside space all day	42.67	56.00	324.00	547.00	11.33	108.00
Mean all moving outside space all day	335.50	1084.80	403.60	882.00	362.00	793.56
Ratio moving outside/inside all day	7.86	19.37	1.25	1.61	31.95	7.35
Public space area (m2)	918.74	288.61	1666.82	1170.33	1095.90	984.30
Isovist area (m2)	7419.72	22541.5	7144.56	12157.9	9213.54	19263.00
Visibility ratio	8.08	78.10	4.29	10.39	8.41	19.57
Enclosure ratio	1.16	0.00	3.18	2.56	0.61	0.13
Sum isovist length total (m)	546.66	2012.21	749.98	1419.43	1258.07	1640.34
Mean isovist length selected (m)	91.11	201.22	83.33	141.94	139.79	182.26
Sum isovist length special (m)	480.01	1609.40	120.77	1314.83	646.55	1086.53
Mean isovist length total (m)	96.00	229.91	60.39	164.35	161.64	217.31
Sum isovist length selected (m)	480.01	1528.91	463.67	1262.65	646.55	1086.53
Mean isovist length special (m)	96.00	254.82	92.73	180.38	161.64	217.31
Sum of the length of axial lines (m)	395.43	456.45	361.25	424.72	410.07	444.24
Mean sum of the length of axial lines (m)	131.81	228.23	180.62	141.57	205.04	148.08
Sum number axial lines	3.00	2.00	2.00	3.00	2.00	3.00
Rn main line	1.32	1.41	1.25	1.40	1.41	1.39
Sum Rn values	3.71	2.72	2.45	4.14	2.68	4.01
Global integration values of T lines	1.32	2.72	1.19	2.77	1.27	2.62
Strategic value	1.32	1.41	1.25	1.40	1.41	1.39
Local strategic values	8.97	7.82	5.83	11.08	7.44	11.19
Rn public space	1.17	1.24	1.12	1.23	1.24	1.23

Data presented for the mean hourly rates, including male and female people
All syntactic values concerning axial lines refer to the effective routes model

Table 5.8. City of London public spaces correlation matrix: spatial, syntactic, levels of pedestrian movement and static occupancy (1/4)

Variable	**Public space area (m2)**	**Isovist area (m2)**	**Visibi-lity ratio**	**Enclo-sure ratio**	**Sum isov. length total**	**Mean sum isov. length total**	**Sum isov. length select.**	**Mean sum isov. length select.**
Public space area (m2)	1.000							
Isovist area (m2)	-.2180	1.000						
Visibility ratio	-.8461	.6358	1.000					
Enclosure ratio	.6177	-.0435	-.6415	1.000				
Sum isovist length total (m)	-.1626	.8994	.5012	-.1068	1.000			
Mean sum isovist length total (m)	-.3218	.8704	.6844	-.4199	.9397	1.000		
Sum isovist length selected (m)	.0784	.9159	.4464	.0206	.7498	.7487	1.000	
Mean sum isov. length selected (m)	-.2998	.8480	.7048	-.4988	.8740	.9829	.7844	1.000
Sum isovist length special (m)	-.0407	.9682	.4780	.1768	.8139	.7342	.9419	.7148
Mean sum isov. length special (m)	-.3849	.9208	.7284	-.3374	.9539	.9855	.7637	.9527
Sum axial lines length (m)	.9871	-.1473	-.7649	.5207	-.1172	-.2355	.1806	-.1899
Mean sum axial lines length (m)	.5143	-.2443	-.5833	.1221	.1656	.0410	-.2490	-.0327
Nº axial lines (C)	.9430	-.2959	-.7605	.4392	-.3288	-.3891	.0758	-.3086
Nº axial lines (T)	-.2585	.9197	.5967	.1743	.6973	.6251	.8291	.5966
Sum nº axial lines	.9461	-.0900	-.6784	.5211	-.1577	-.2506	.2708	-.1805
Sum R3 value (C)	.9626	-.1995	-.7380	.4182	-.1833	-.2559	.1550	-.1876
Sum R3 value (T)	-.1801	.8756	.5511	.1976	.5930	.5413	.8531	.5419
Local strategic value	.9327	.0311	-.6123	.4981	-.0237	-.1203	.3787	-.0559
Sum Rn value (C)	.9476	-.2700	-.7515	.4318	-.2950	-.3562	.1002	-.2771
Sum Rn value (T)	-.3301	.9192	.6660	.0891	.6849	.6438	.8238	.6248
Strategic value	.9260	-.0018	-.6180	.5117	-.0838	-.1753	.3558	-.1044
Rn value main line	-.6498	.7210	.9036	-.7078	.7272	.9014	.5615	.9158
Mean nº suits all day	.9285	.1030	-.6062	.5963	.0429	-.0951	.4211	-.0512
Mean nº suits not at pubs all day	.9285	-.0432	-.6376	.5142	-.1301	-.2182	.3196	-.1445
Mean nº suits 8 – 4:40 pm	.8945	.1626	-.5459	.5894	.0708	-.0605	.4813	-.0117
Mean nº suits – October data	.9557	.0124	-.6607	.5569	-.0207	-.1445	.3436	-.0947
Mean nº suits not at pubs – October data	.9634	-.0587	-.6887	.5188	-.0841	-.1905	.2856	-.1325
Mean nº moving people inside public space all day	.6114	.3859	-.3770	.8796	.2685	-.0060	.4907	-.0571
Mean nº moving people inside public space 8 am – 4:40 pm	.5499	.4457	-.3038	.8568	.3137	.0440	.5323	-.0092
Travel distance	-.2705	-.3583	.2367	-.4972	-.6196	-.3402	-.1877	-.1854

Table 5.8. City of London public spaces correlation matrix: spatial, syntactic, levels of pedestrian movement and static occupancy (2/4)

Variable	Sum isovist length special	Mean sum isovist length special	Sum axial lines length	Mean sum axial line length	N° axial lines (C)	N° axial lines (T)	Sum n° axial lines
Public space area (m2)							
Isovist area (m2)							
Visibility ratio							
Enclosure ratio							
Sum isovist length total (m)							
Mean sum isovist length total (m)							
Sum isovist length selected (m)							
Mean sum isov. length selected (m)							
Sum isovist length special (m)	1.0000						
Mean sum isov. length special (m)	.7981	1.0000					
Sum axial lines length (m)	.0194	-.3115	1.0000				
Mean sum axial lines length (m)	-.2775	-.0550	.4645	1.0000			
N° axial lines (C)	-.1238	-.4705	.9661	.3190	1.0000		
N° axial lines (T)	.9495	.7294	-.2163	-.5045	-.3227	1.0000	
Sum n° axial lines	.0969	-.3121	.9757	.2602	.9745	-.1078	1.0000
Sum R3 value (C)	-.0444	-.3463	.9900	.4267	.9856	-.2805	.9757
Sum R3 value (T)	.9336	.6399	-.1246	-.5897	-.1964	.9822	.0135
Local strategic value	.2063	-.1829	.9712	.2850	.9431	-.0187	.9908
Sum Rn value (C)	-.1014	-.4399	.9730	.3374	.9993	-.3091	.9780
Sum Rn value (T)	.9330	.7453	-.2792	-.5565	-.3704	.9954	-.1625
Strategic value	.1828	-.2329	.9638	.2280	.9526	-.0256	.9960
Rn value main line	.5332	.8917	-.5512	-.2225	-.6154	.5217	-.5292
Mean n° suits all day	.2908	-.1375	.9546	.2744	.9018	.0776	.9736
Mean n° suits not at pubs all day	.1445	-.2761	.9641	.2178	.9630	-.0572	.9983
Mean n° suits 8 – 4:40 pm	.3526	-.0954	.9277	.2013	.8780	.1496	.9628
Mean n° suits – October data	.1930	-.2019	.9810	.3350	.9394	-.0315	.9877
Mean n° suits not at pubs – October data	.1173	-.2578	.9902	.3510	.9641	-.1091	.9939
Mean n° moving people inside public space all day	.5894	.0653	.5764	.0351	.4512	.5181	.6118
Mean n° moving people inside public space 8 am – 4:40 pm	.6420	.1234	.5183	-.0164	.3898	.5832	.5616
Travel distance	-.3752	-.3732	-.1916	-.6277	.0579	-.2592	-.0490

Table 5.8. City of London public spaces correlation matrix: spatial, syntactic, levels of pedestrian movement and static occupancy (3/4)

Variable	Sum R3 value (C)	Sum R3 value (T)	Local stra-tegic value	Sum Rn value (C)	Sum Rn value (T)	Starte-gic value	Rn value main line
Public space area (m2)							
Isovist area (m2)							
Visibility ratio							
Enclosure ratio							
Sum isovist length total (m)							
Mean sum isovist length total (m)							
Sum isovist length selected (m)							
Mean sum isov. length selected (m)							
Sum isovist length special (m)							
Mean sum isov. length special (m)							
Sum axial lines length (m)							
Mean sum axial lines length (m)							
N° axial lines (C)							
N° axial lines (T)							
Sum n° axial lines							
Sum R3 value (C)	1.0000						
Sum R3 value (T)	-.1742	1.0000					
Local strategic value	.9644	.0909	1.0000				
Sum Rn value (C)	.9911	-.1859	.9514	1.0000			
Sum Rn value (T)	-.3329	.9798	-.0745	-.3574	1.0000		
Strategic value	.9609	.0944	.9970	.9582	-.0794	1.0000	
Rn value main line	-.5290	.4505	-.4280	-.5924	.5781	-.4636	1.0000
Mean n° suits all day	.9284	.1753	.9894	.9109	.0135	.9848	-.4342
Mean n° suits not at pubs all day	.9644	.0672	.9930	.9670	-.1101	.9989	-.4950
Mean n° suits 8 – 4:40 pm	.9019	.2522	.9824	.8870	.0884	.9800	-.3916
Mean n° suits – October data	.9640	.0684	.9960	.9477	-.0939	.9910	-.4723
Mean n° suits not at pubs – October data	.9827	-.0036	.9945	.9710	-.1682	.9913	-.4991
Mean n° moving people inside public space all day	.4756	.5492	.6443	.4574	.4394	.6428	-.3589
Mean n° moving people inside public space 8 am – 4:40 pm	.4157	.6099	.5996	.3966	.5079	.5980	-.2985
Travel distance	-.0656	-.1278	-.1233	.0358	-.1861	-.0667	.0143

Table 5.8. City of London public spaces correlation matrix: spatial, syntactic, levels of pedestrian movement and static occupancy (4/4)

Variable	Mean nº suits all day	Mean nº suits not at pubs all day	Mean nº suits 8 am – 4:40 pm	Mean nº suits – October data	Mean nº suits not at pubs – Oct. data	Mean nº mov. people inside public space all day	Mean nº moving people inside public space 8 – 4:40 pm	Travel distance
Public space area (m2)								
Isovist area (m2)								
Visibility ratio								
Enclosure ratio								
Sum isovist length total (m)								
Mean sum isovist length total (m)								
Sum isovist length selected (m)								
Mean sum isov. length selected (m)								
Sum isovist length special (m)								
Mean sum isov. length special (m)								
Sum axial lines length (m)								
Mean sum axial lines length (m)								
Nº axial lines (C)								
Nº axial lines (T)								
Sum nº axial lines								
Sum R3 value (C)								
Sum R3 value (T)								
Local strategic value								
Sum Rn value (C)								
Sum Rn value (T)								
Strategic value								
Rn value main line								
Mean nº suits all day	1.000							
Mean nº suits not at pubs all day	.9778	1.000						
Mean nº suits 8 – 4:40 pm	.9964	.9718	1.000					
Mean nº suits – October data	.9937	.9868	.9823	1.000				
Mean nº suits not at pubs – October data	.9810	.9901	.9656	.9963	1.000			
Mean nº moving people inside public space all day	.7470	.6272	.7664	.6796	.6205	1.000		
Mean nº moving people inside public space 8 am – 4:40 pm	.7072	.5806	.7321	.6329	.5694	.9968	1.000	
Travel distance	-.2264	-.0367	-.2006	-.1932	-.1395	-.5396	-.5386	1.000

Notes:

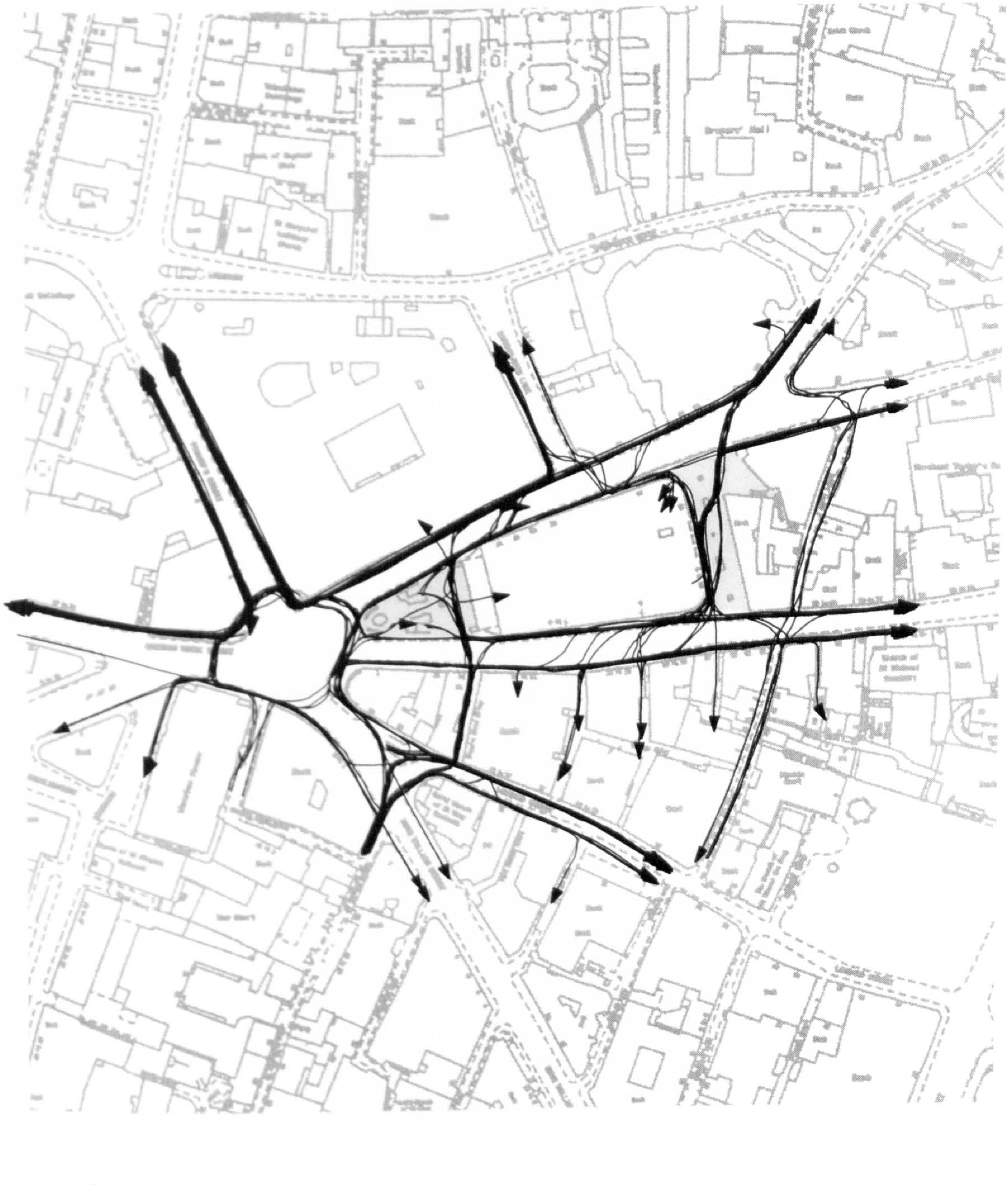
5 observations were used in this computation
7 cases were omitted due to missing values
Because of the low number of cases, P axial lines (number and integration values), number of intersection points, mean number at pubs (July/August and October data) could not be added in the table

APPENDIX 4

CITY OF LONDON PUBLIC SPACES: PATTERNS OF PEDESTRIAN MOVEMENT AND STATIC OCCUPANCY

Plate 6.2. Pattern of pedestrian movement: Bank Corner and Royal Exchange (1/3) scale: 1:2500

morning peak: 8:00 am to 9:20 am

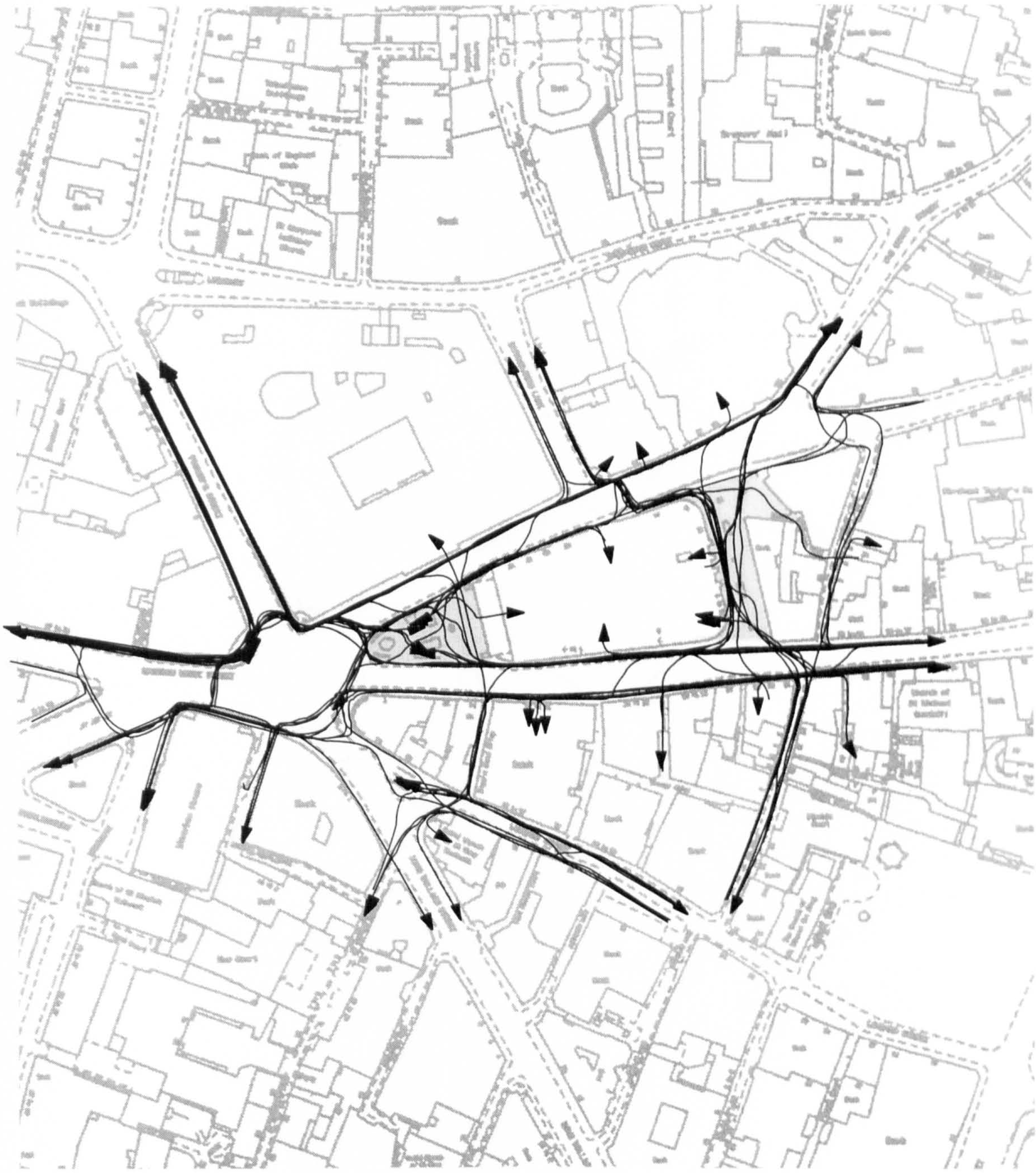


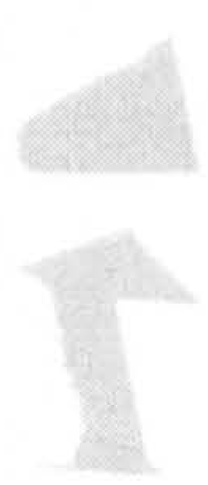
Bank Corner

Royal Exchange

Plate 6.2. Pattern of pedestrian movement: Bank Corner and Royal Exchange (2/3) scale 1:2500

lunch time: 12:00 pm to 2:10 pm



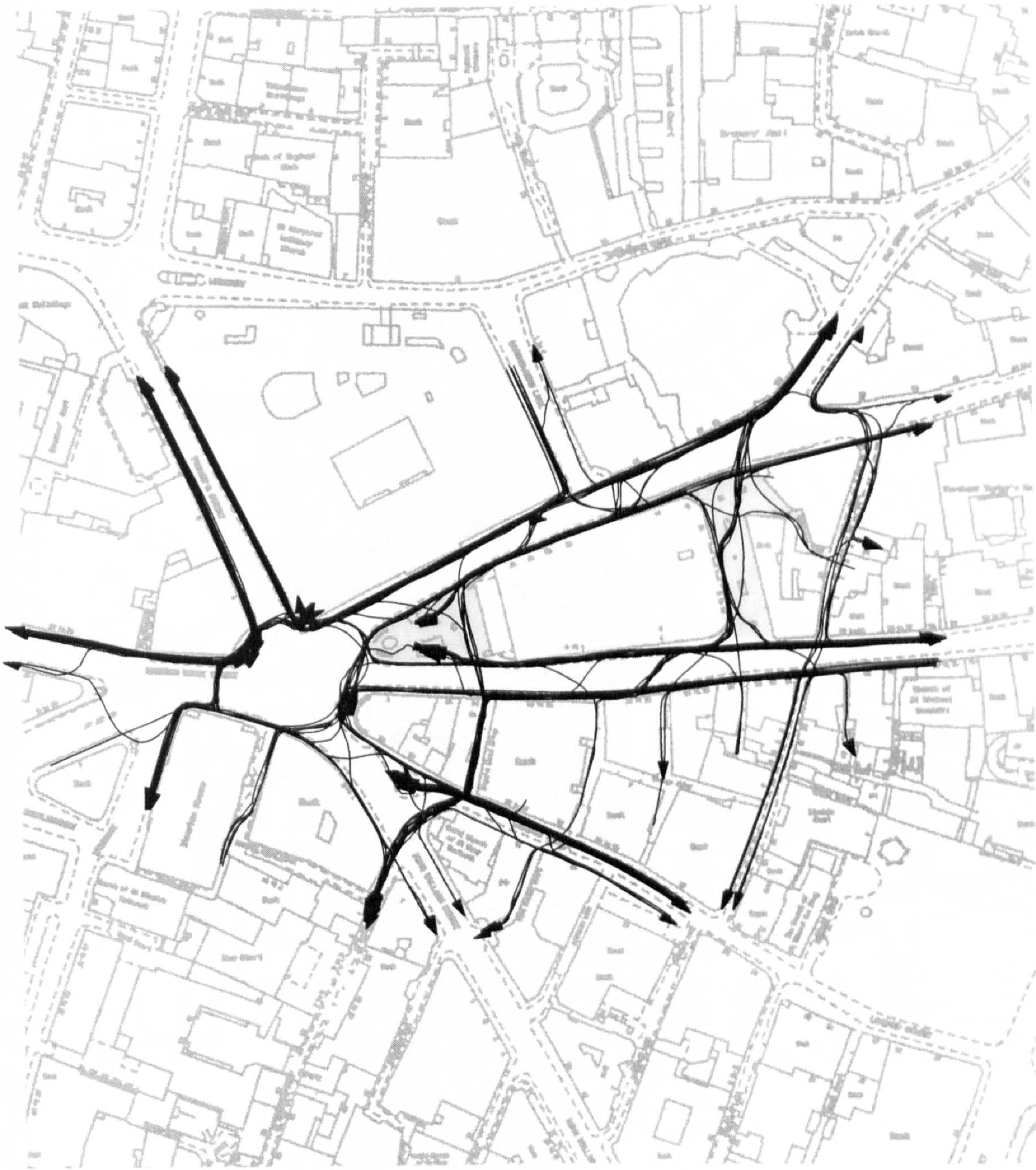


Bank Corner

Royal Exchange

Plate 6.2. Pattern of pedestrian movement: Bank Corner and Royal Exchange (3/3) scale 1:2500

evening peak: 4:50 pm to 6:10 pm



Bank Corner

Royal Exchange

Plate 6.3. Pattern of pedestrian movement: Fenchurch Place (1/3)

scale: 1:2500

morning peak: 8:00 am to 9:20 am

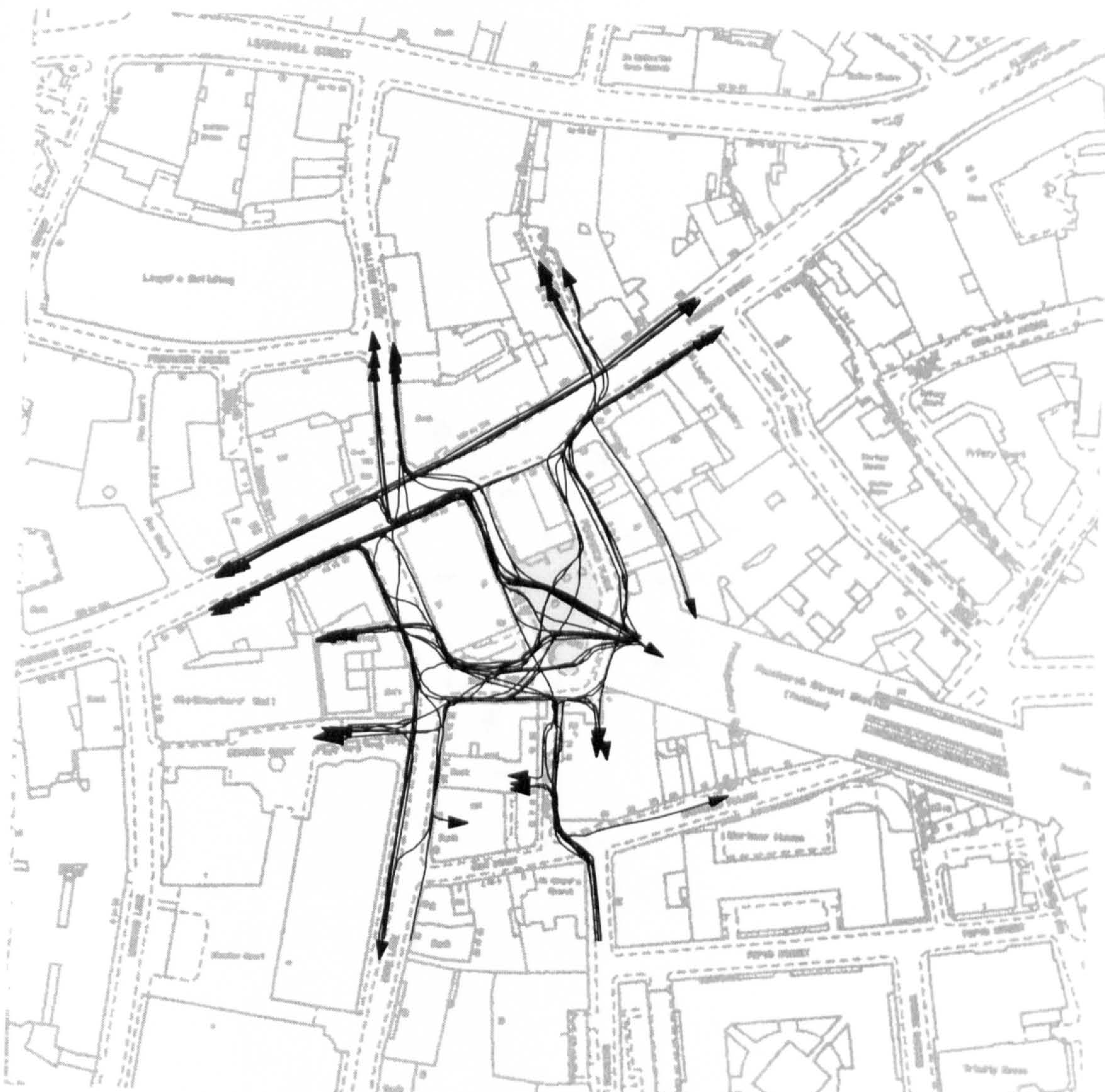


Plate 6.3. Pattern of pedestrian movement: Fenchurch Place (2/3)

scale 1:2500

lunch time: 12:00 pm to 2:10 pm

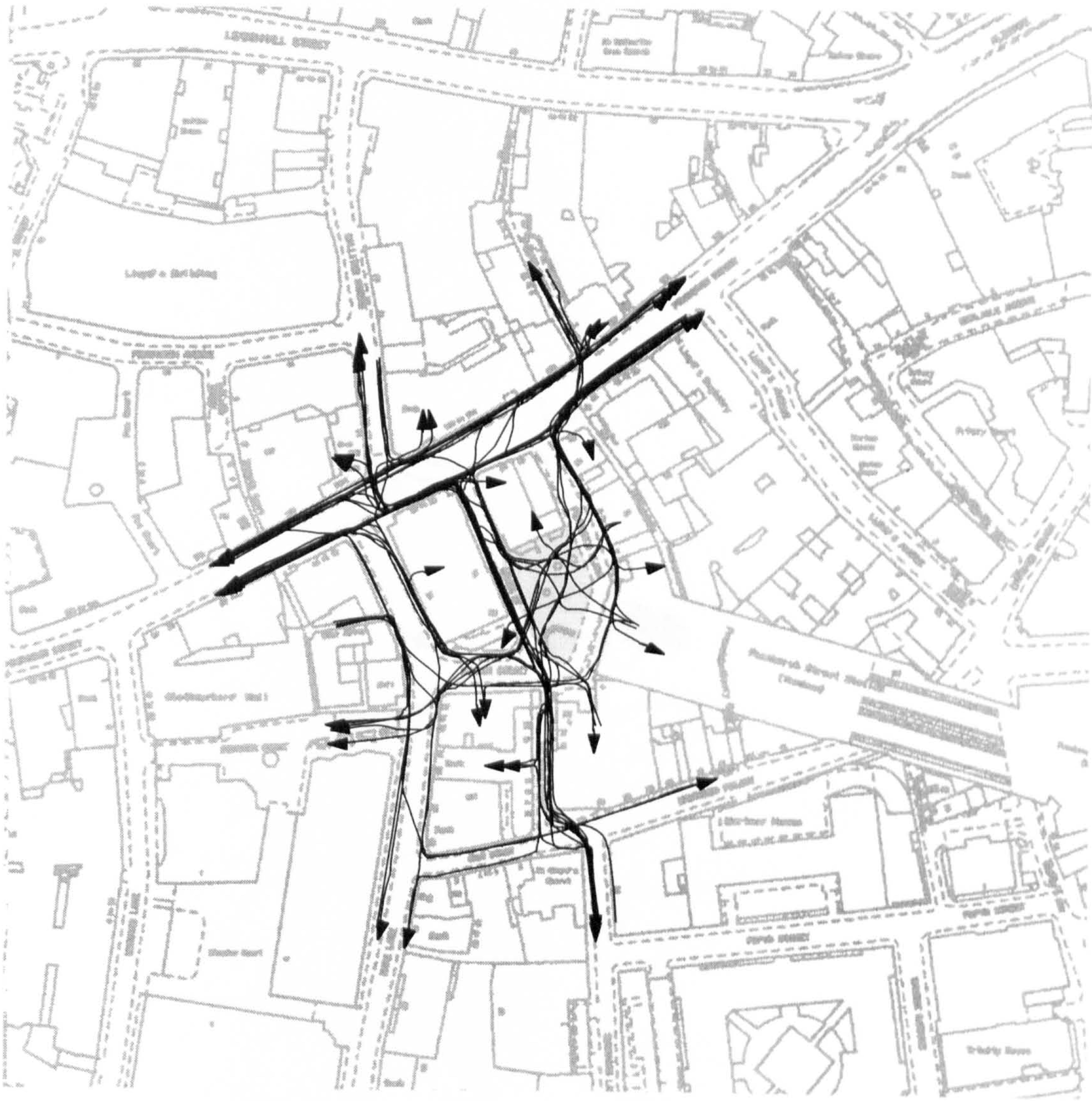


Plate 6.3. Pattern of pedestrian movement: Fenchurch Place (3/3)

scale 1:2500

evening peak: 4:50 pm to 6:10 pm

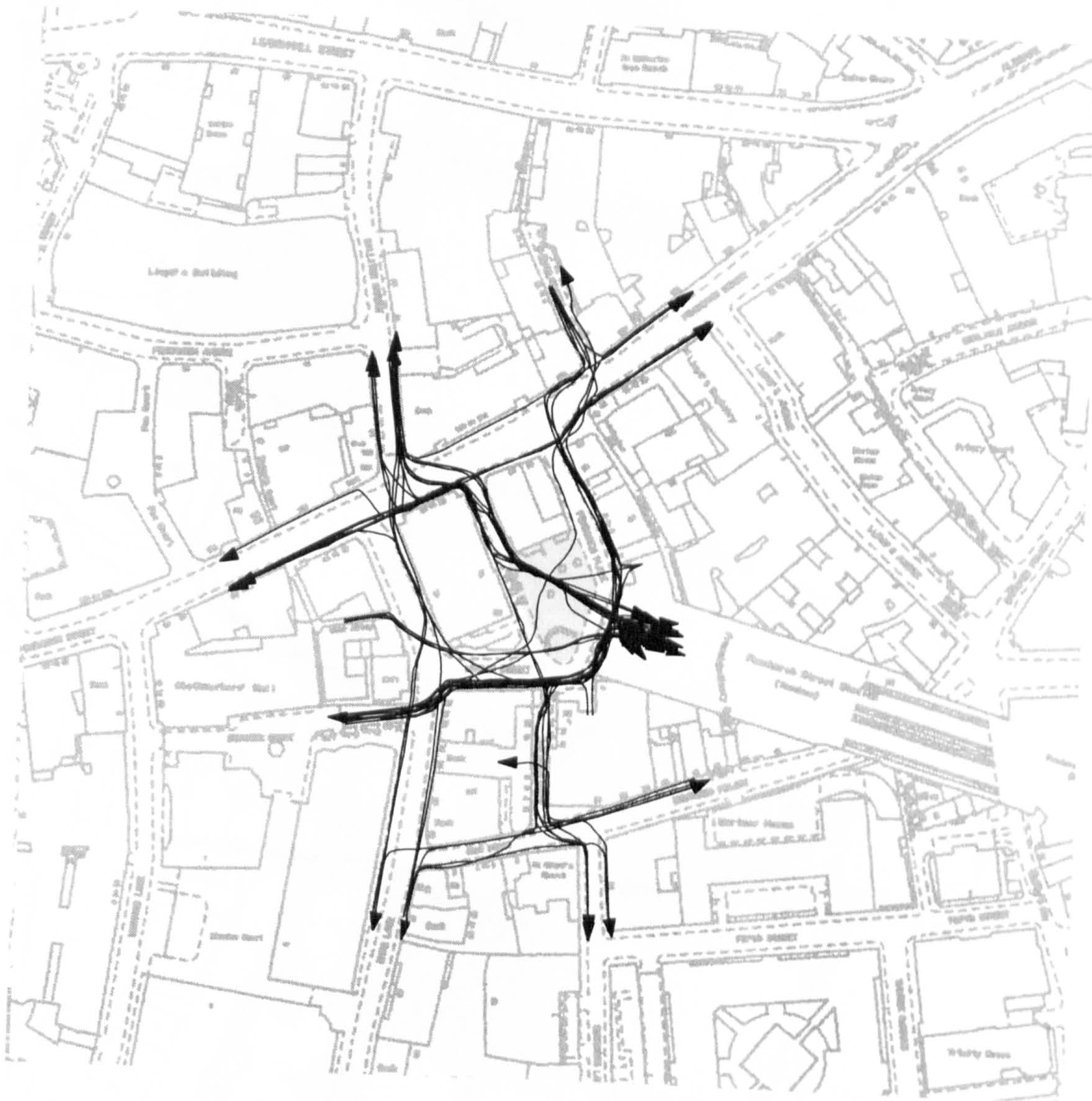


Plate 6.4. Pattern of pedestrian movement: Finsbury Av. and Exchange Square (1/3)

scale 1:2500

morning peak: 8:00 am to 9:20 am

Finsbury Av. Exchange Square

Plate 6.4. Pattern of pedestrian movement: Finsbury Av. and Exchange Square (2/3)

scale 1:2500

lunch time: 12:00 pm to 2:10 pm

Finsbury Av.

Exchange Square

Plate 6.4. Pattern of pedestrian movement: Finsbury Av. and Exchange Square (3/3)

scale 1:2500

evening peak: 4:50 pm to 6:10 pm

Finsbury Av.   Exchange Square

Plate 6.5. Pattern of pedestrian movement: Fleet Place (1/3)

scale 1:2500

morning peak: 8:00 am to 9:20 am

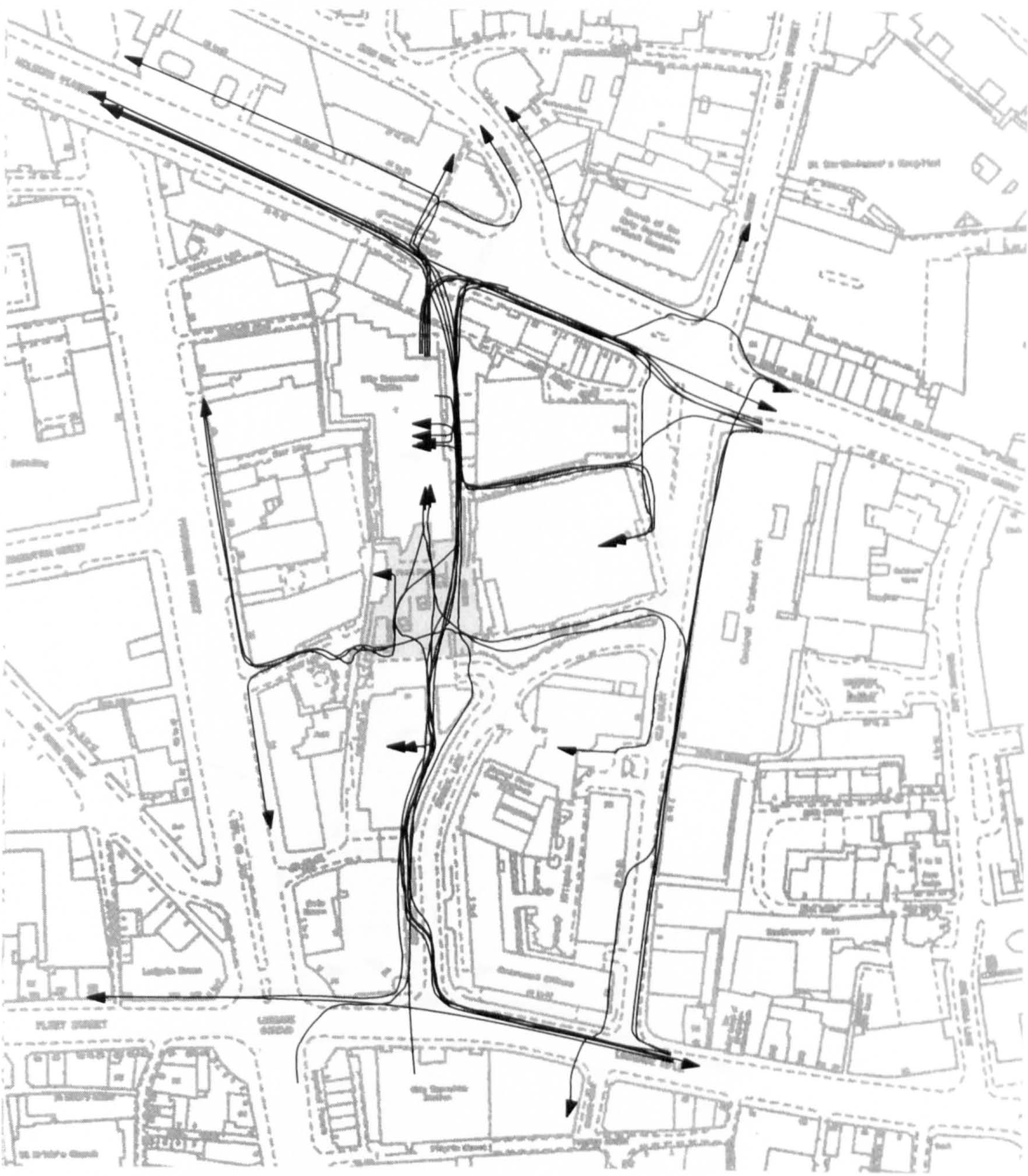


Plate 6.5. Pattern of pedestrian movement: Fleet Place (2/3)

scale: 1:2500

lunch time: 12:00 pm to 2:10 pm

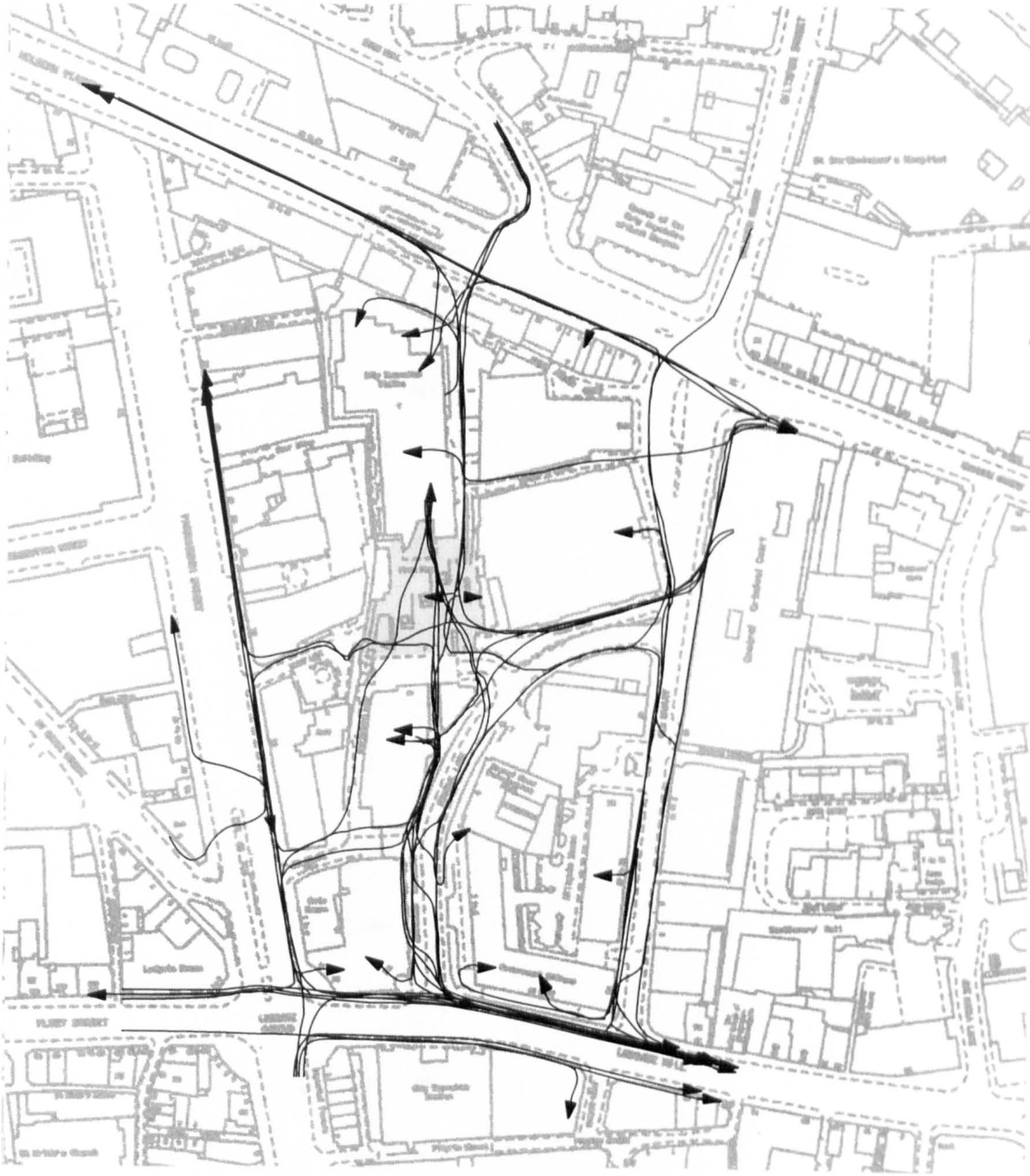


Plate 6.5. Pattern of pedestrian movement: Fleet Place (3/3)

scale 1:2500

evening peak: 4:50 pm to 6:10 pm

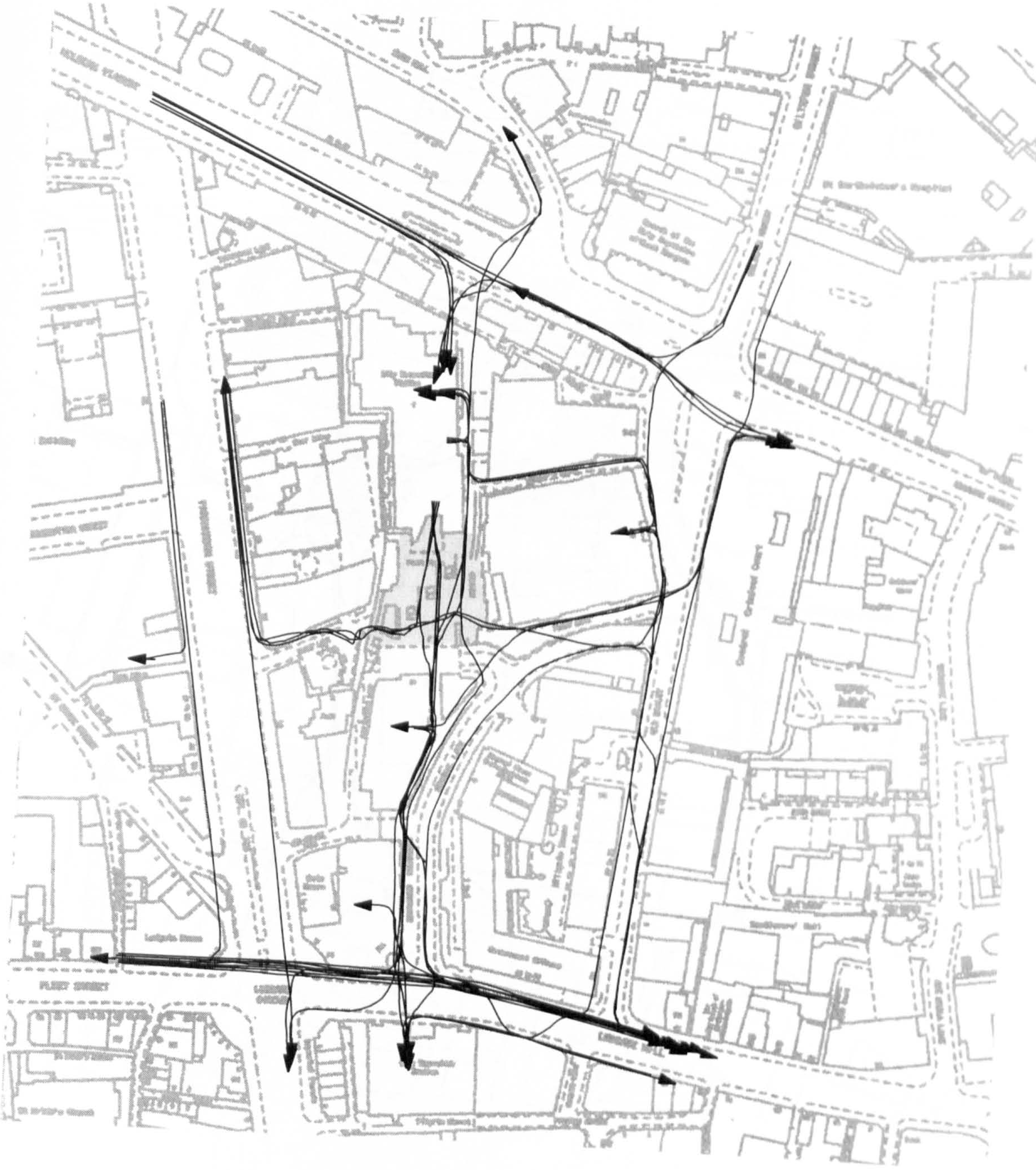
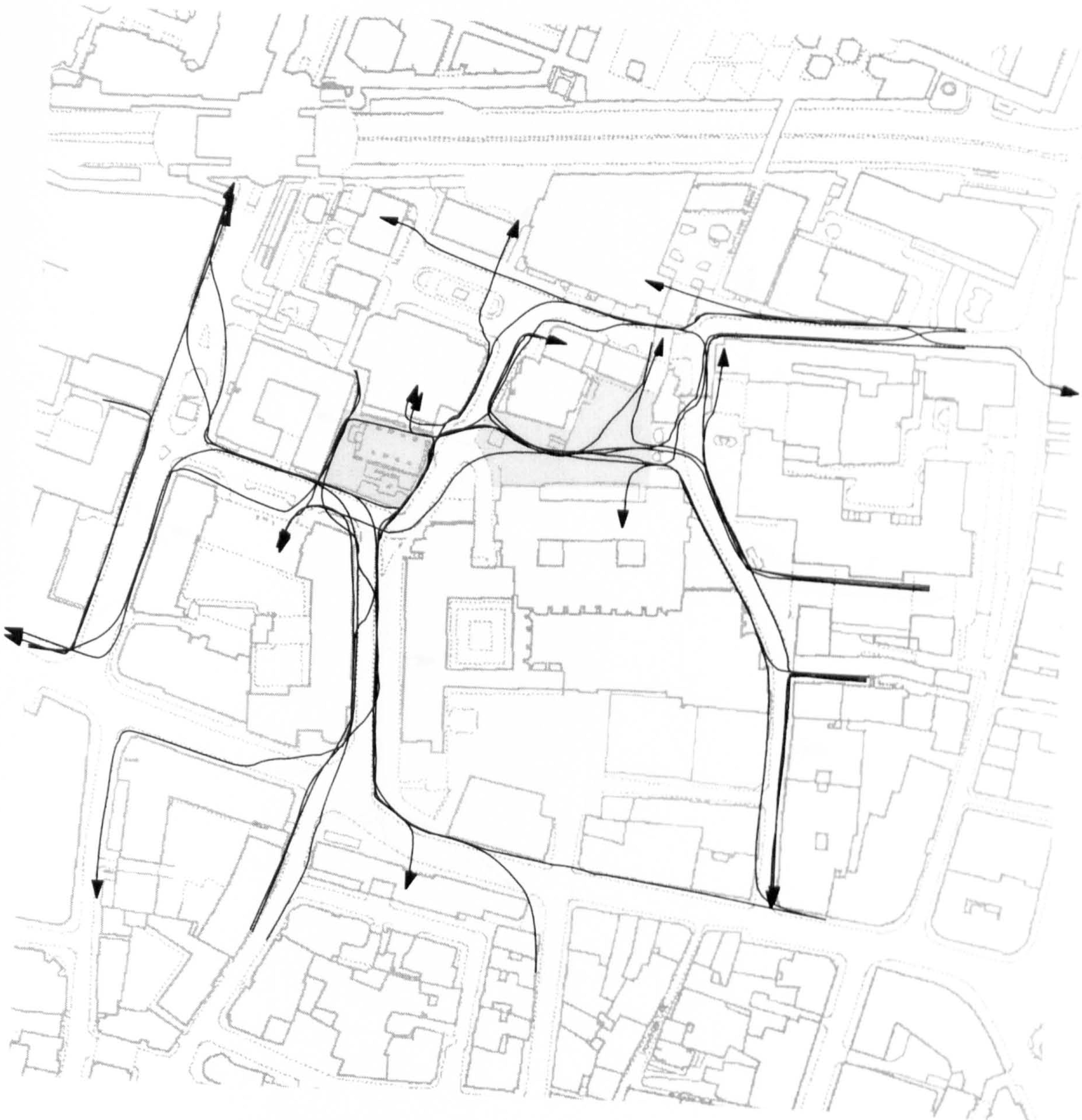


Plate 6.6. Pattern of pedestrian movement: Love Lane Corner and North Guildhall (1/3)

scale 1:2500

morning peak: 8:00 am to 9:20 am



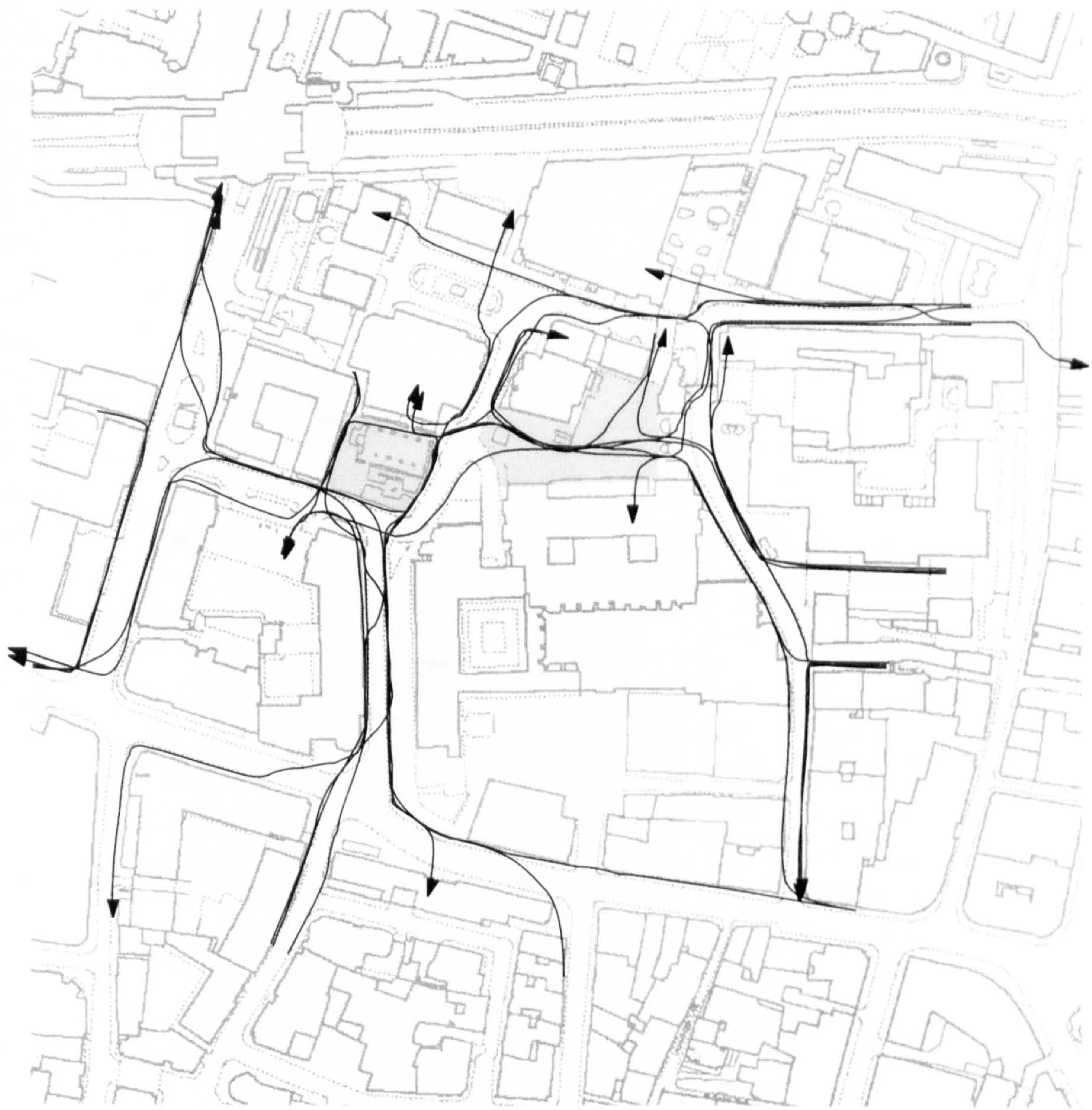
Love Lane

North Guildhall

Plate 6.6. Pattern of pedestrian movement: Love Lane Corner and North Guildhall (1/3)

scale 1:2500

morning peak: 8:00 am to 9:20 am

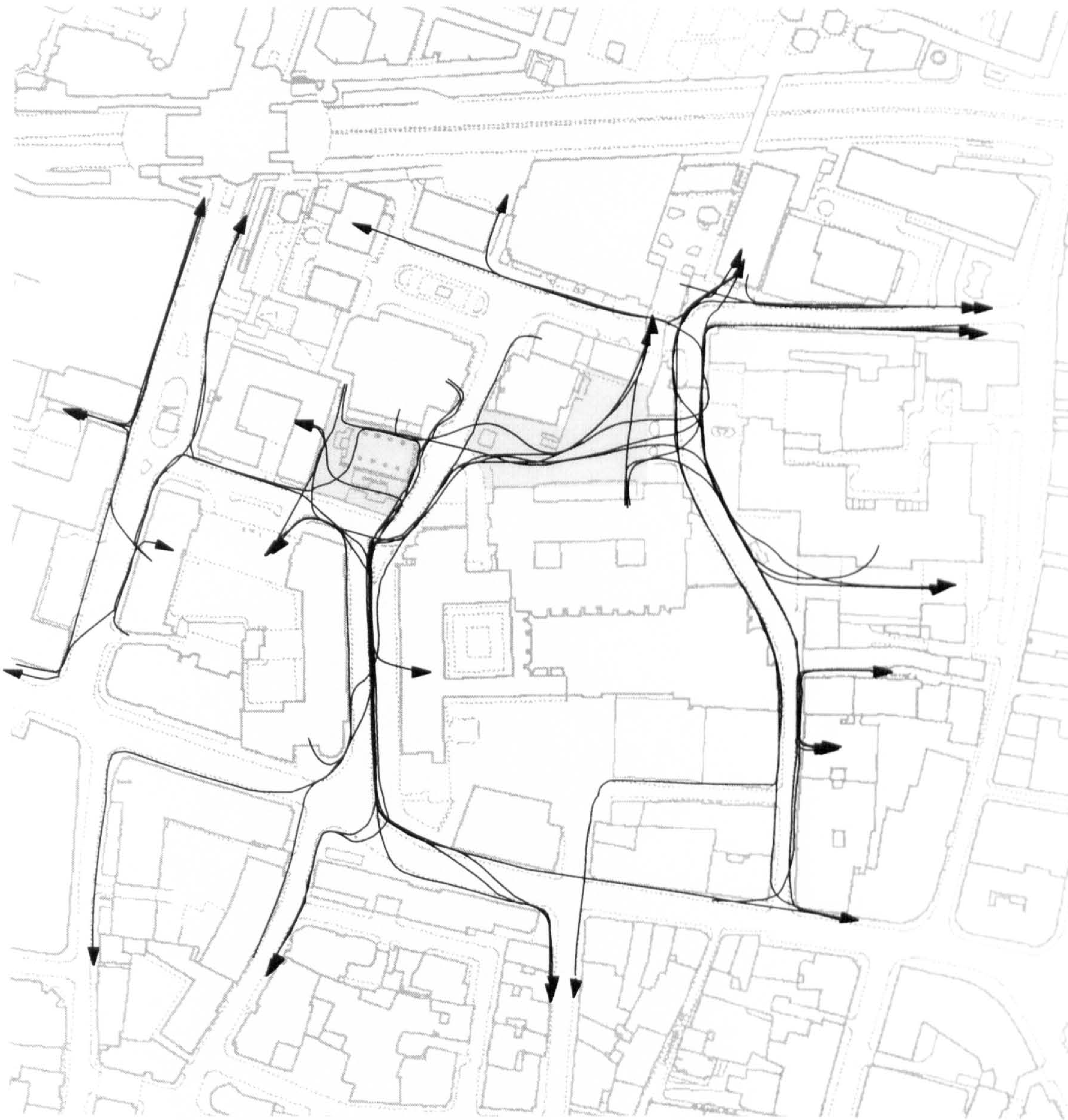


Love Lane

North Guildhall

Plate 6.6. Pattern of pedestrian movement: Love Lane Corner and North Guildhall (2/3) scale 1 2500

lunch time: 12:00 pm to 2:10 pm



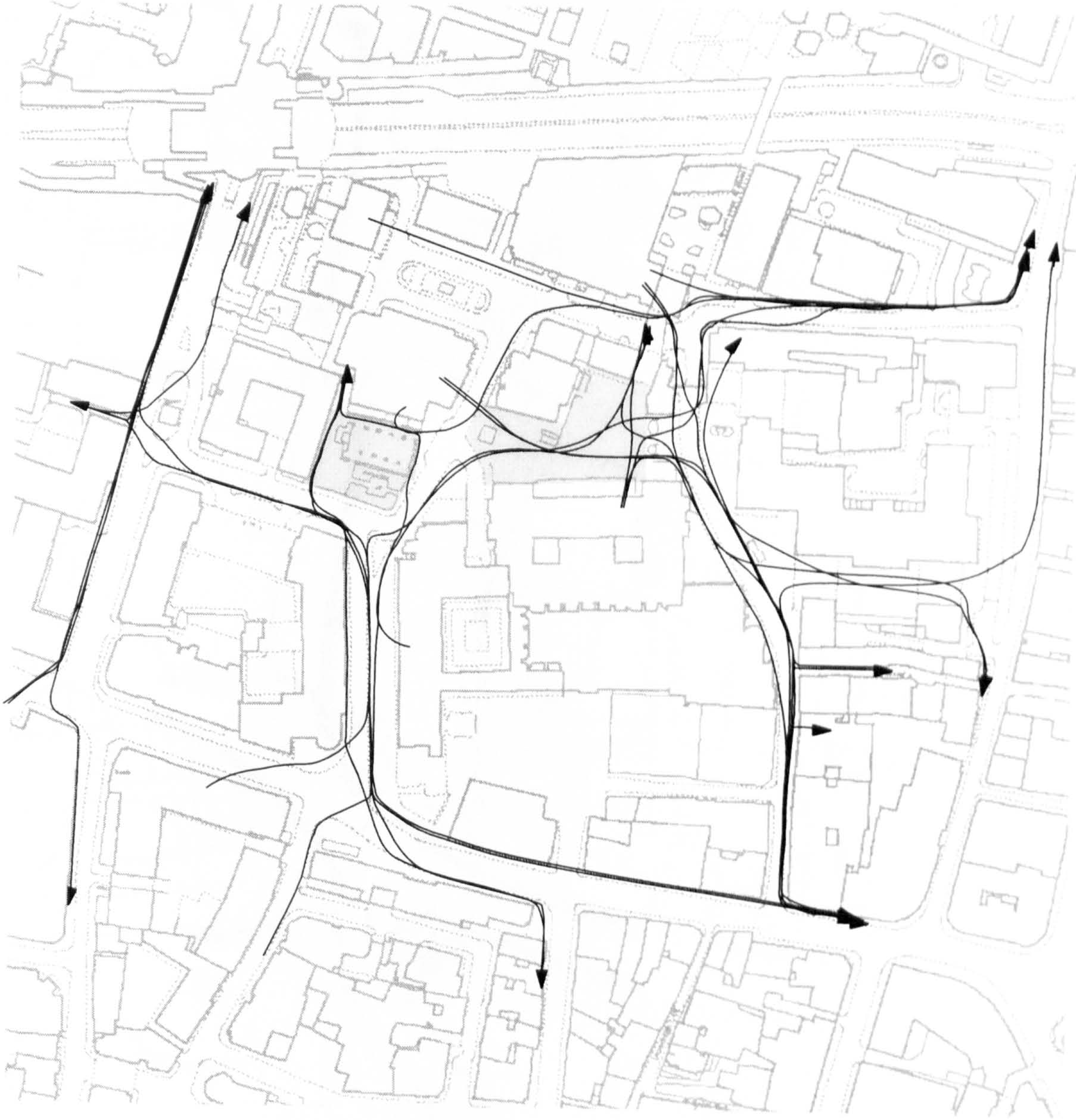
Love Lane

North Guildhall

Plate 6.6. Pattern of pedestrian movement: Love Lane Corner and North Guildhall (3/3)

scale 1:2500

evening peak: 4:50 pm to 6:10 pm



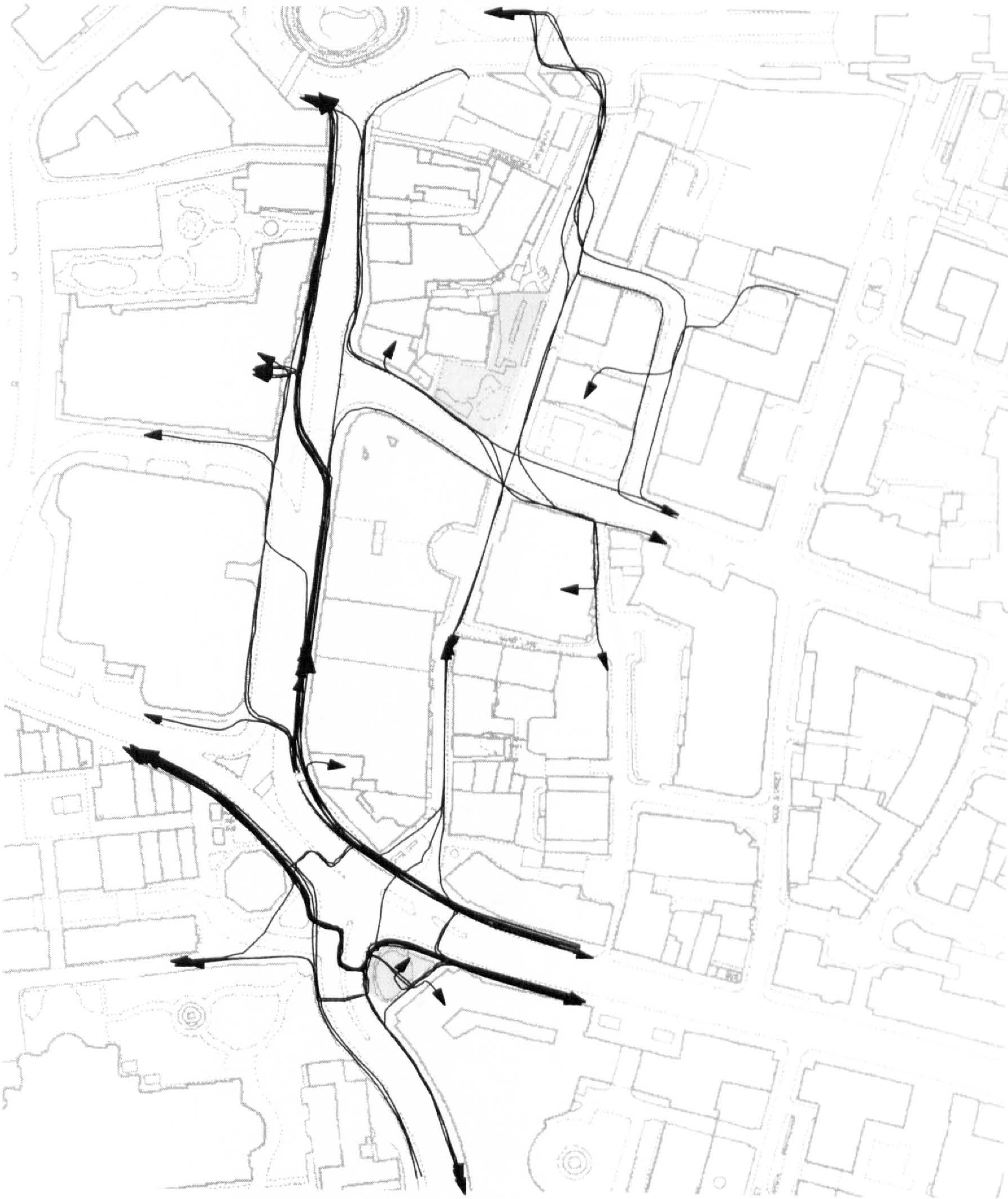
Love Lane

North Guildhall

Plate 6.7. Pattern of pedestrian movement: New Change/Cheapside Corner and St. Anne & St. Agnes churchyard (1/3)

scale 1:2500

morning peak: 8:00 am to 9:20 am

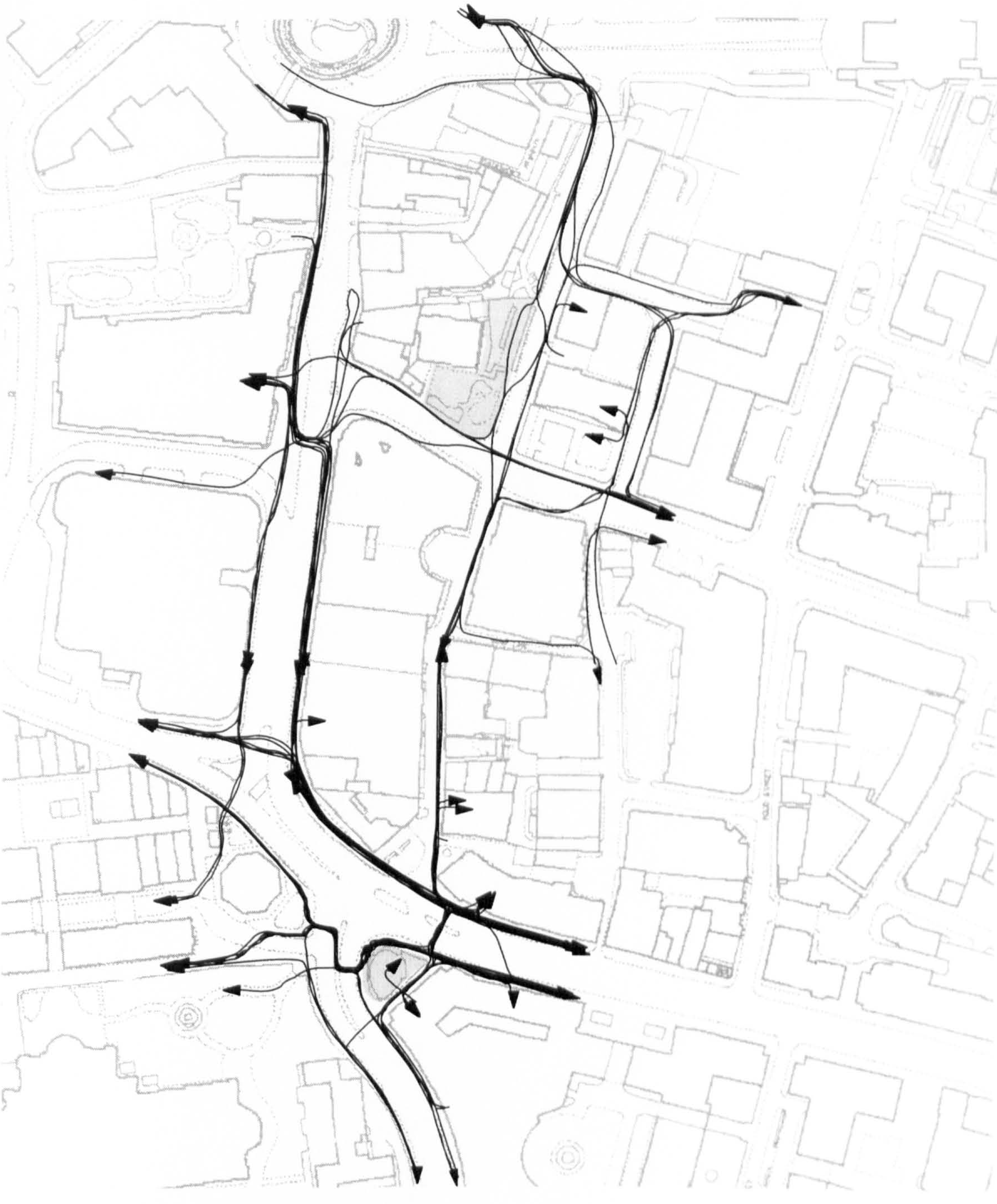


New Change/Cheapside Corner

St. Anne & St. Agnes churchyard

Plate 6.7. Pattern of pedestrian movement: New Change/Cheapside Corner and St. Anne & St. Agnes churchyard (2/3) scale 1:2500

lunch time: 12:00 pm to 2:10 pm



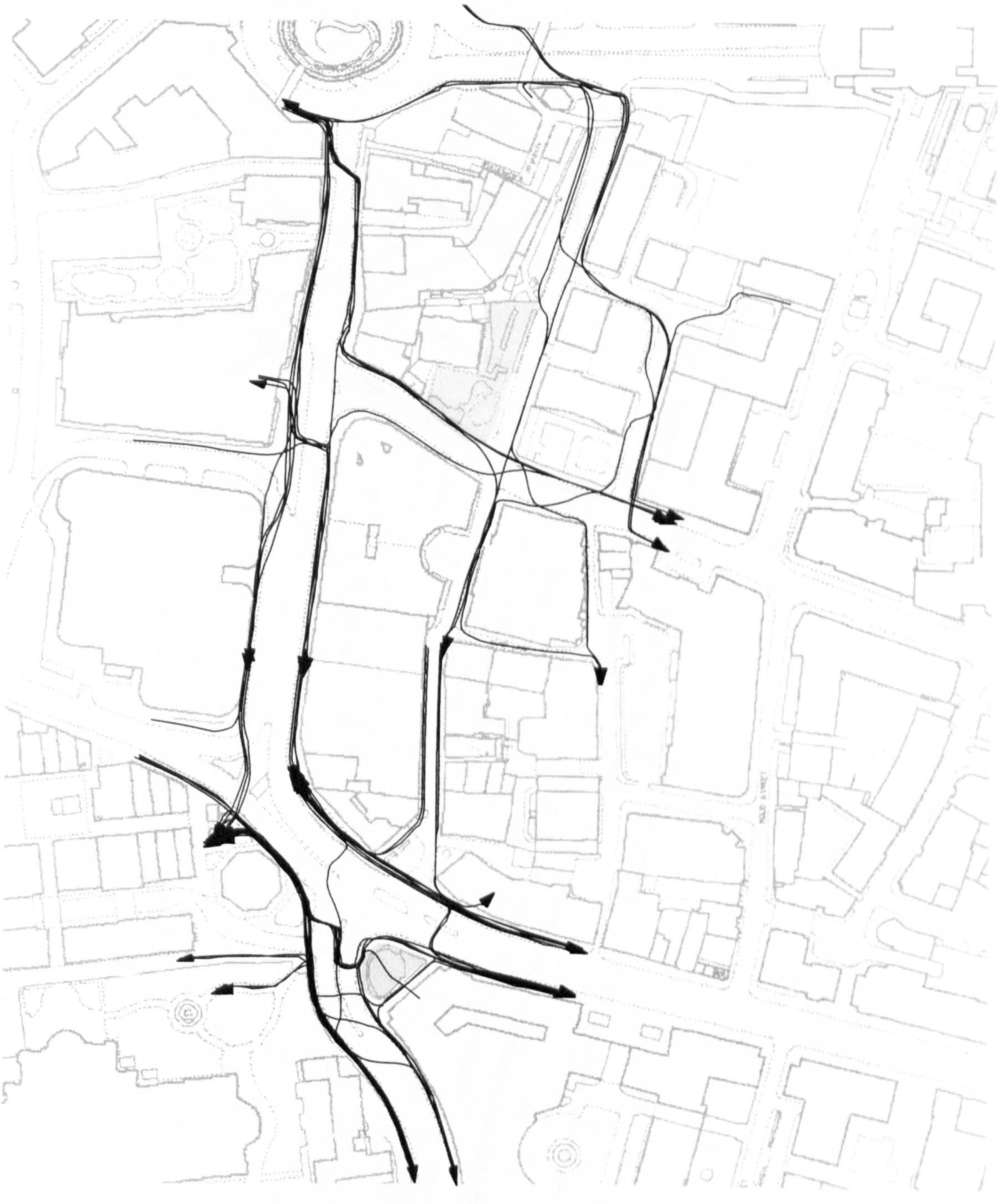
New Change/Cheapside Corner

St. Anne & St. Agnes churchyard

Plate 6.7. Pattern of pedestrian movement: New Change/Cheapside Corner and St. Anne & St. Agnes churchyard (3/3)

scale 1 2500

evening peak: 4:50 pm to 6:10 pm



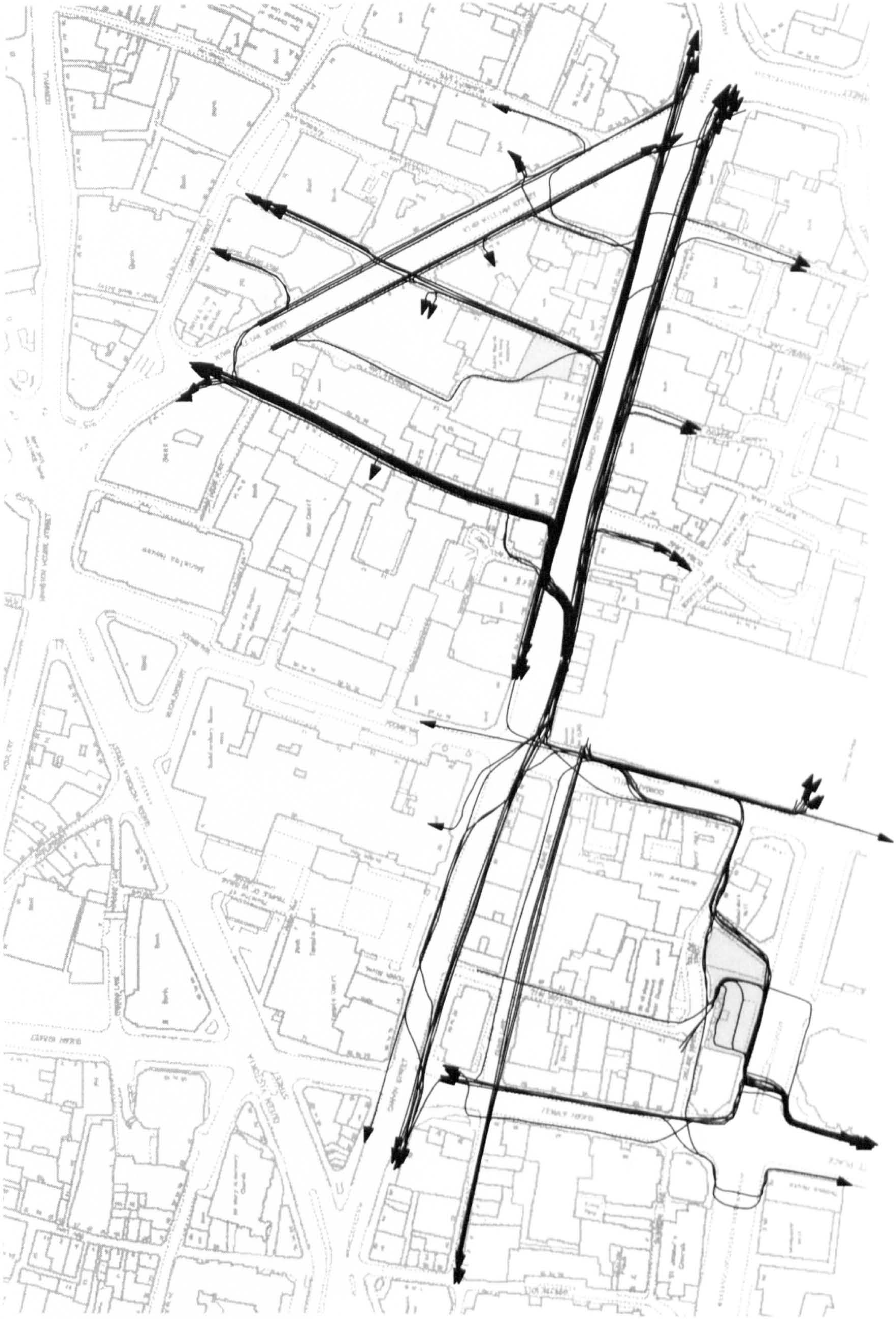
New Change/Cheapside Corner

St. Anne & St. Agnes churchyard

Plate 6.8. Pattern of pedestrian movement: Whittington Gardens and Abchurchyard (1/3)

scale 1:2500

morning peak: 8:00 am to 9:20 am



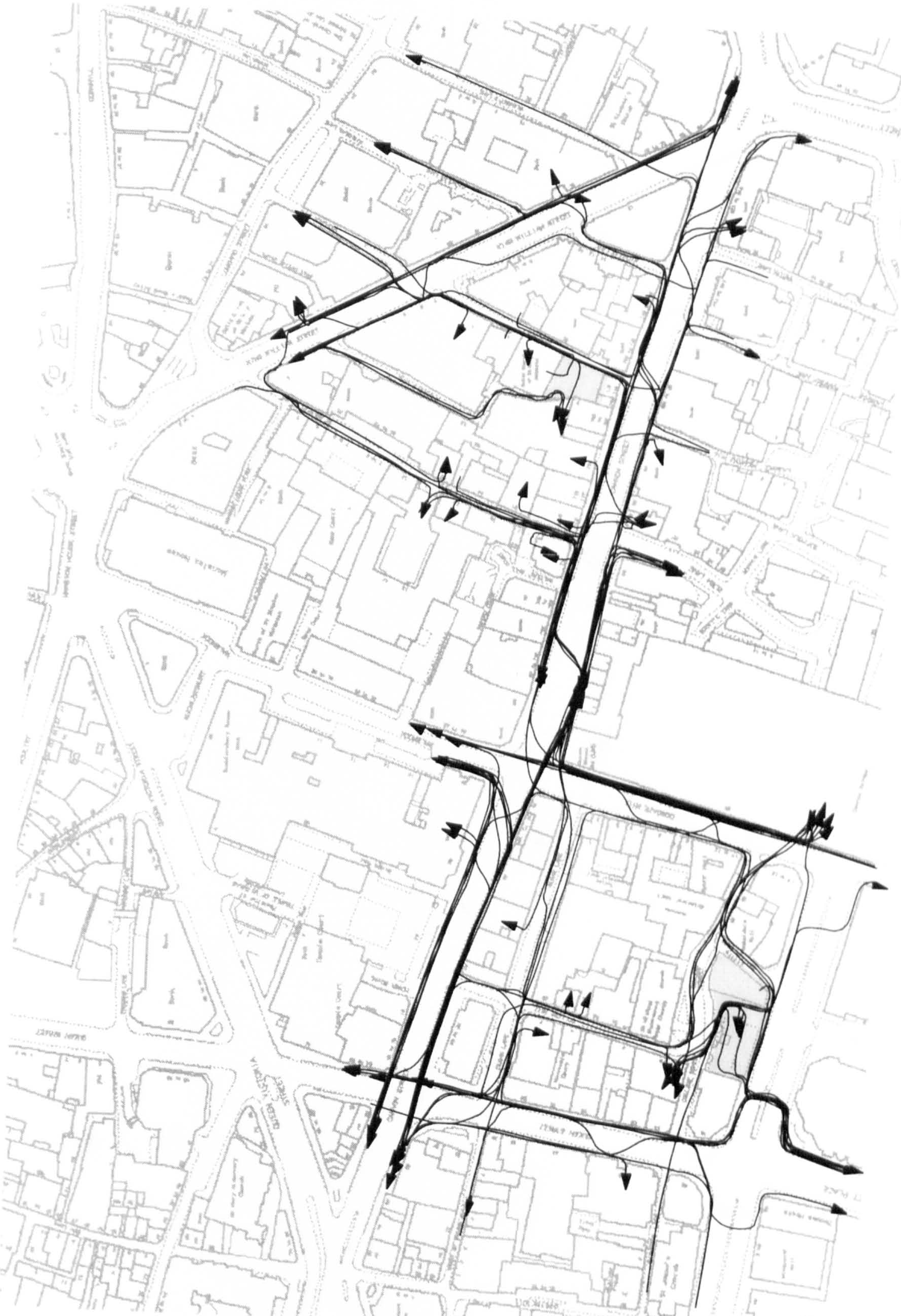
Whittingon Gardens

Abchurchyard

Plate 6.8. Pattern of pedestrian movement: Whittington Gardens and Abchurchyard (2/3)

scale 1:2500

lunch time: 12:00 pm to 2:10 pm



Whittingon Gardens

Abchurchyard

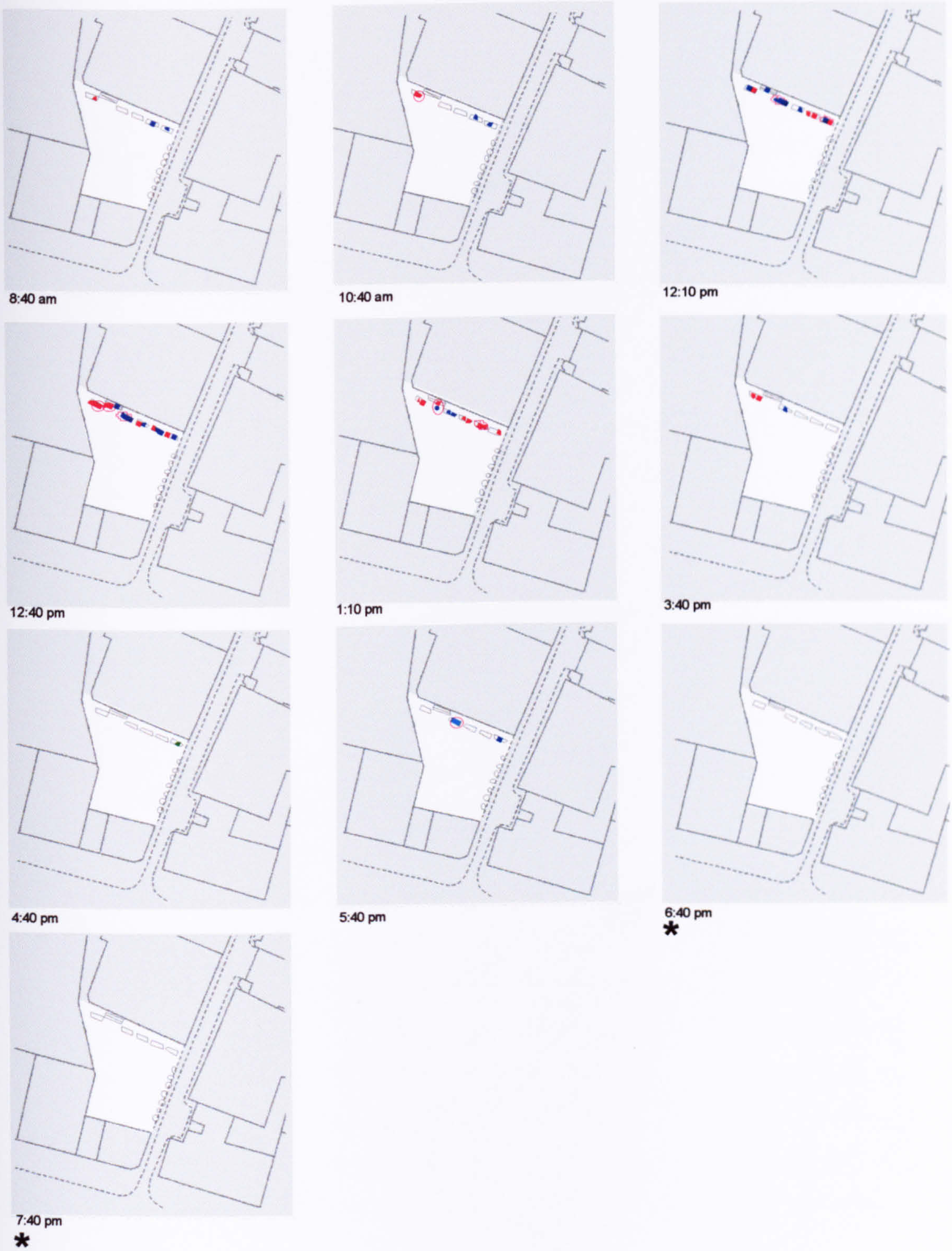
Plate 6.8. Pattern of pedestrian movement: Whittington Gardens and Abchurchyard (3/3) scale: 1:2500

evening peak: 4:50 pm to 6:10 pm

Whittingon Gardens Abchurchyard

Plate 6.9. Pattern of static people distribution: Abchurchyard (1/2)

scale: 1:1200



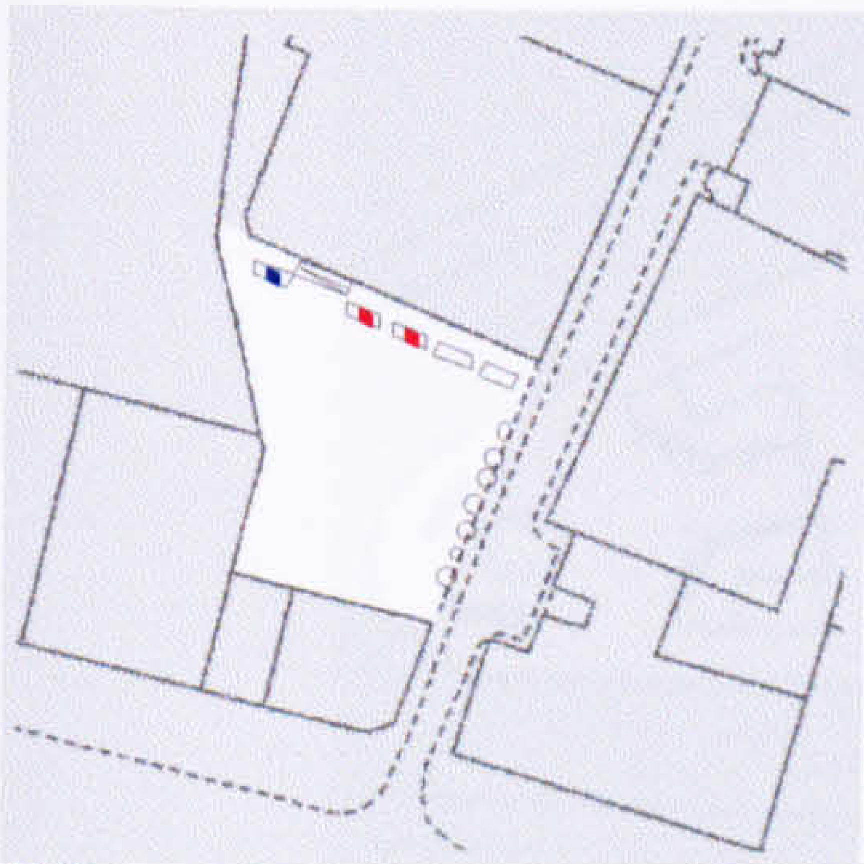
City worker male
City worker female
office smokers
tourists
others

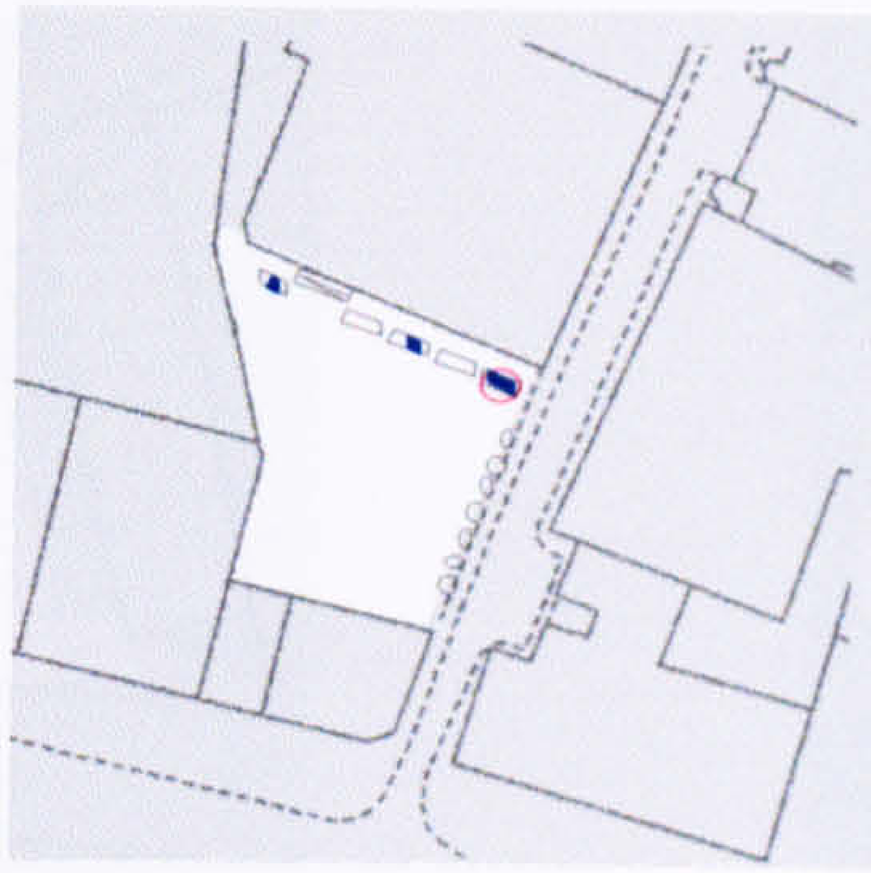
talking
sitting
standing
* no one observed

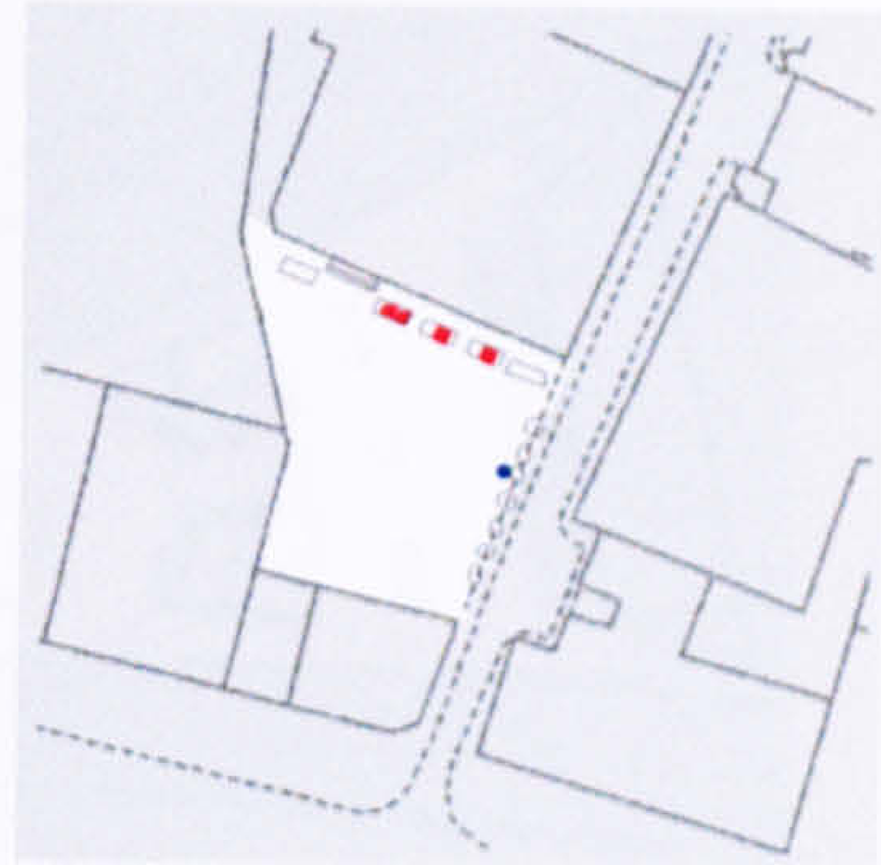
5th August 96, mean temperature = 20.6 C, sunny

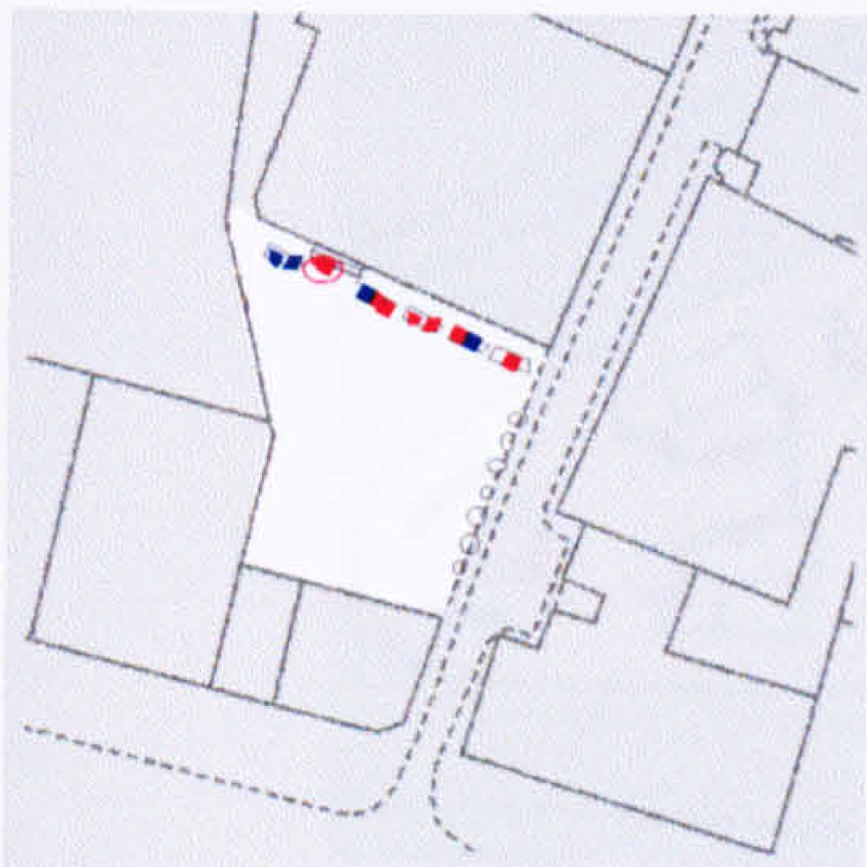
Plate 6.9. Pattern of static people distribution: Abchurchyard (2/2)

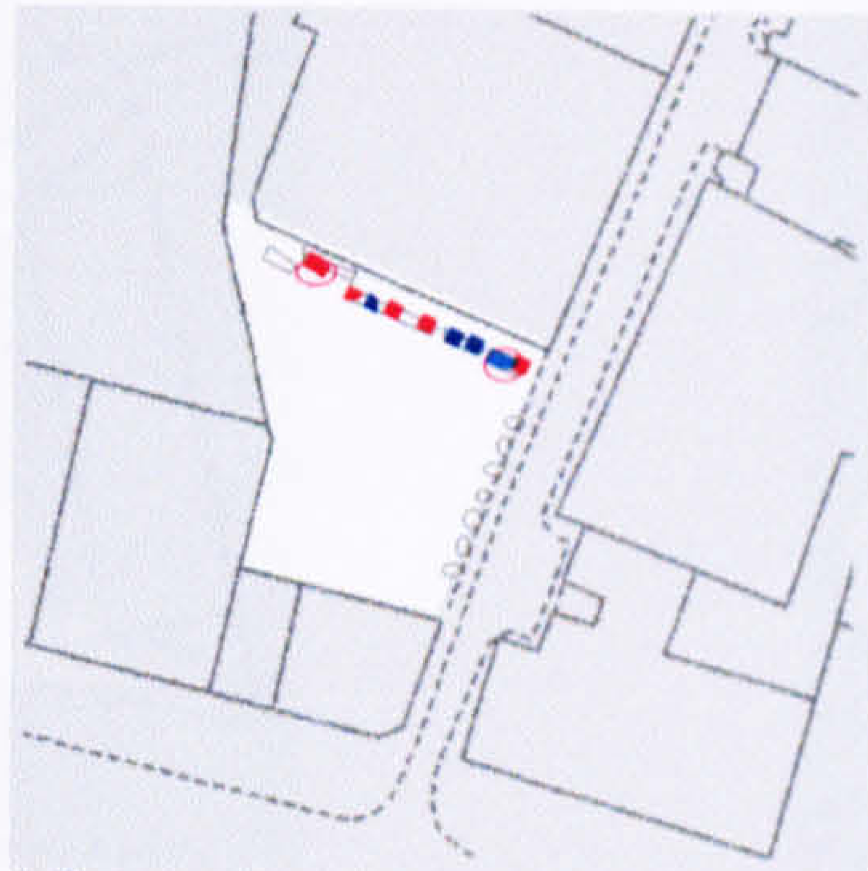
scale: 1:1200

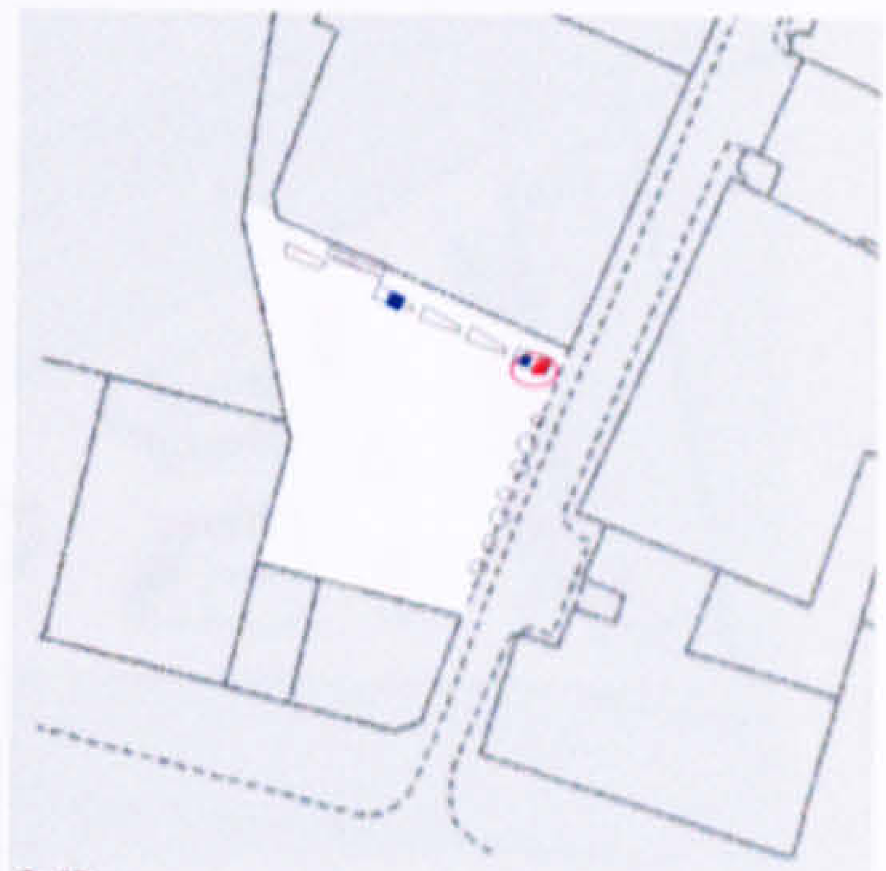

8:40 am

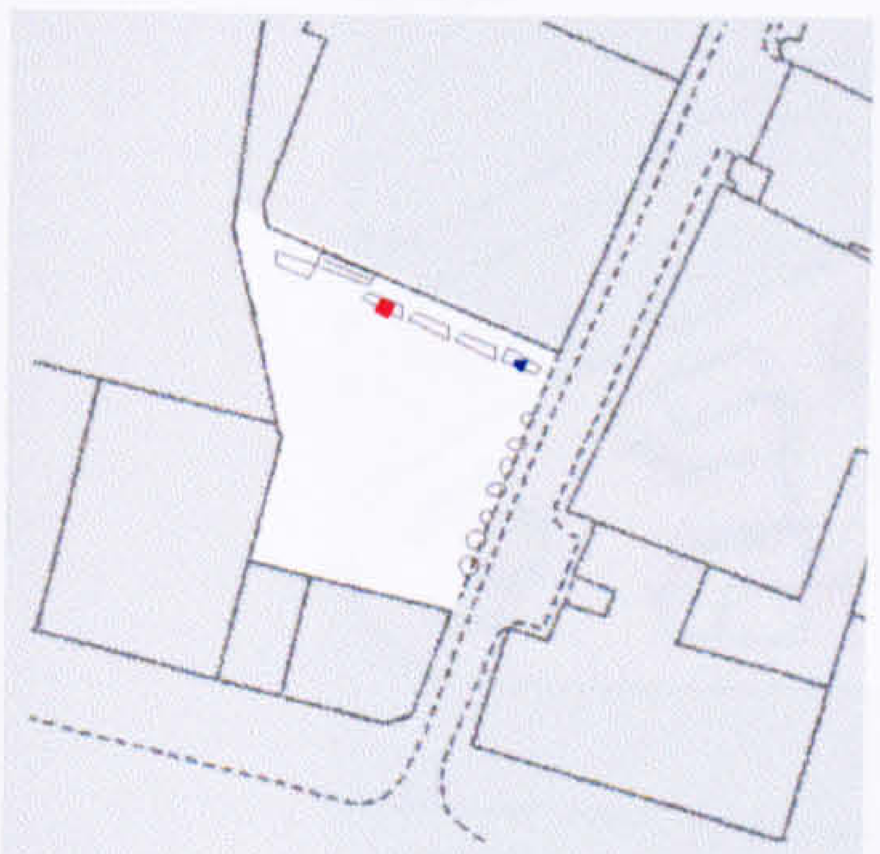

10:40 am

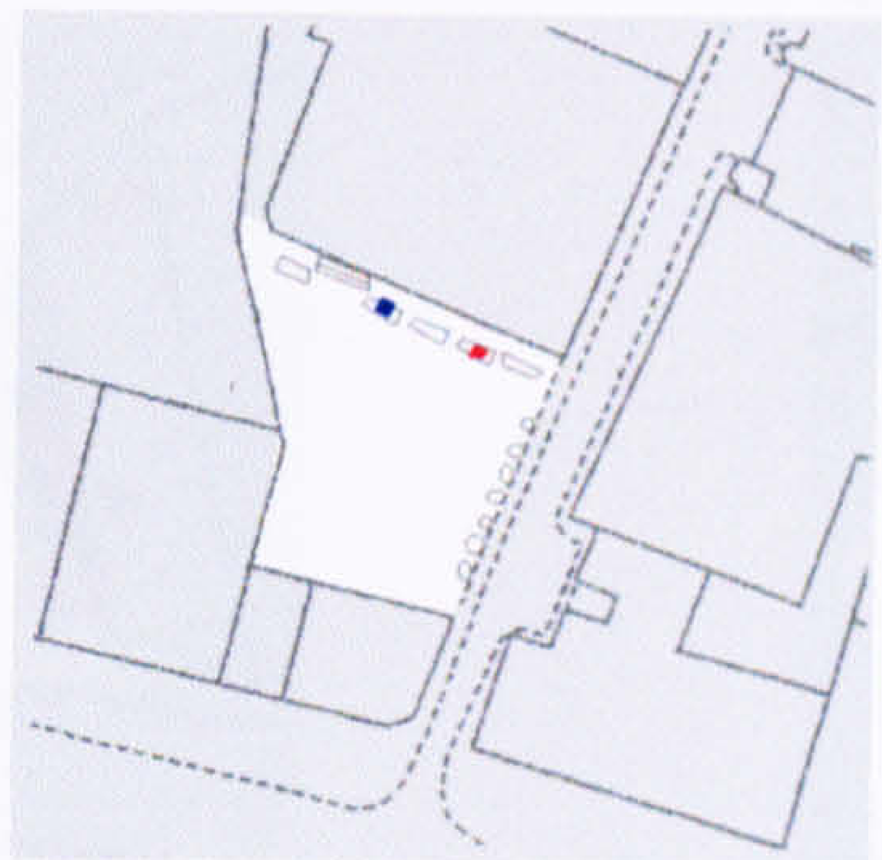

12:10 pm

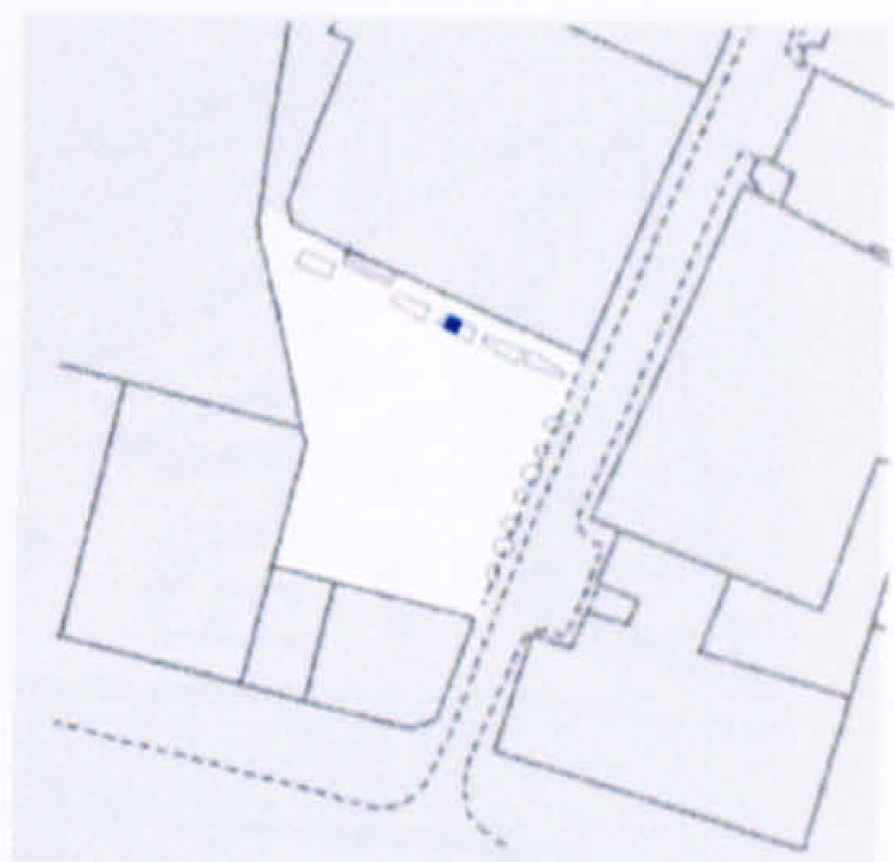

12:40 pm

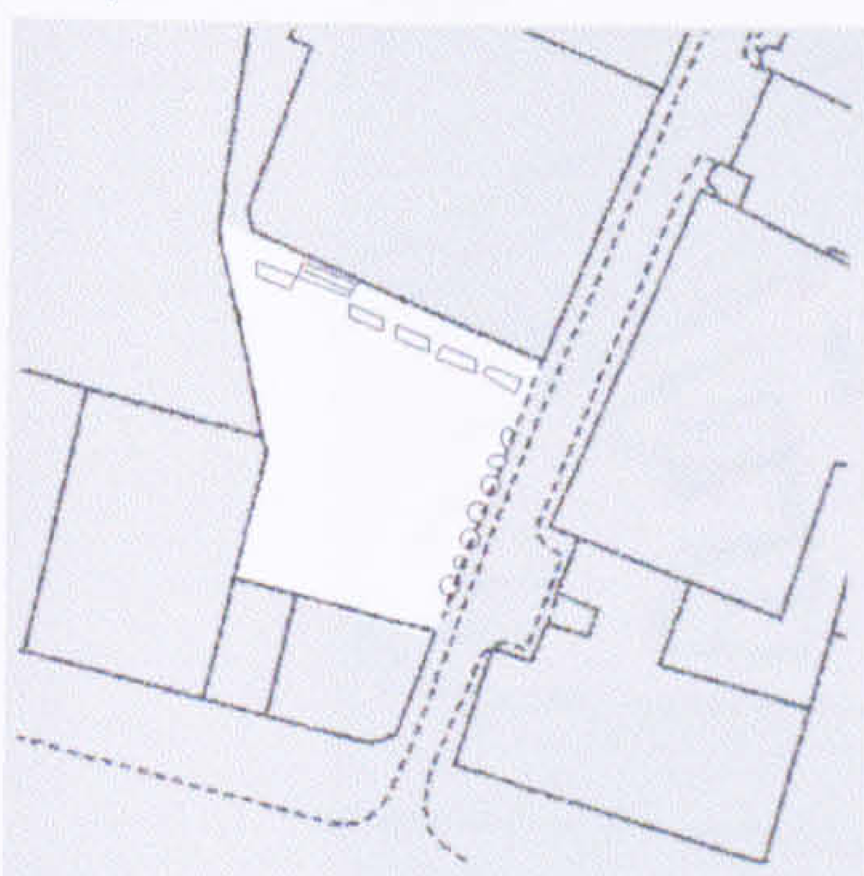

1:10 pm


3:40 pm


4:40 pm


5:40 pm


6:40 pm


7:40 pm

*

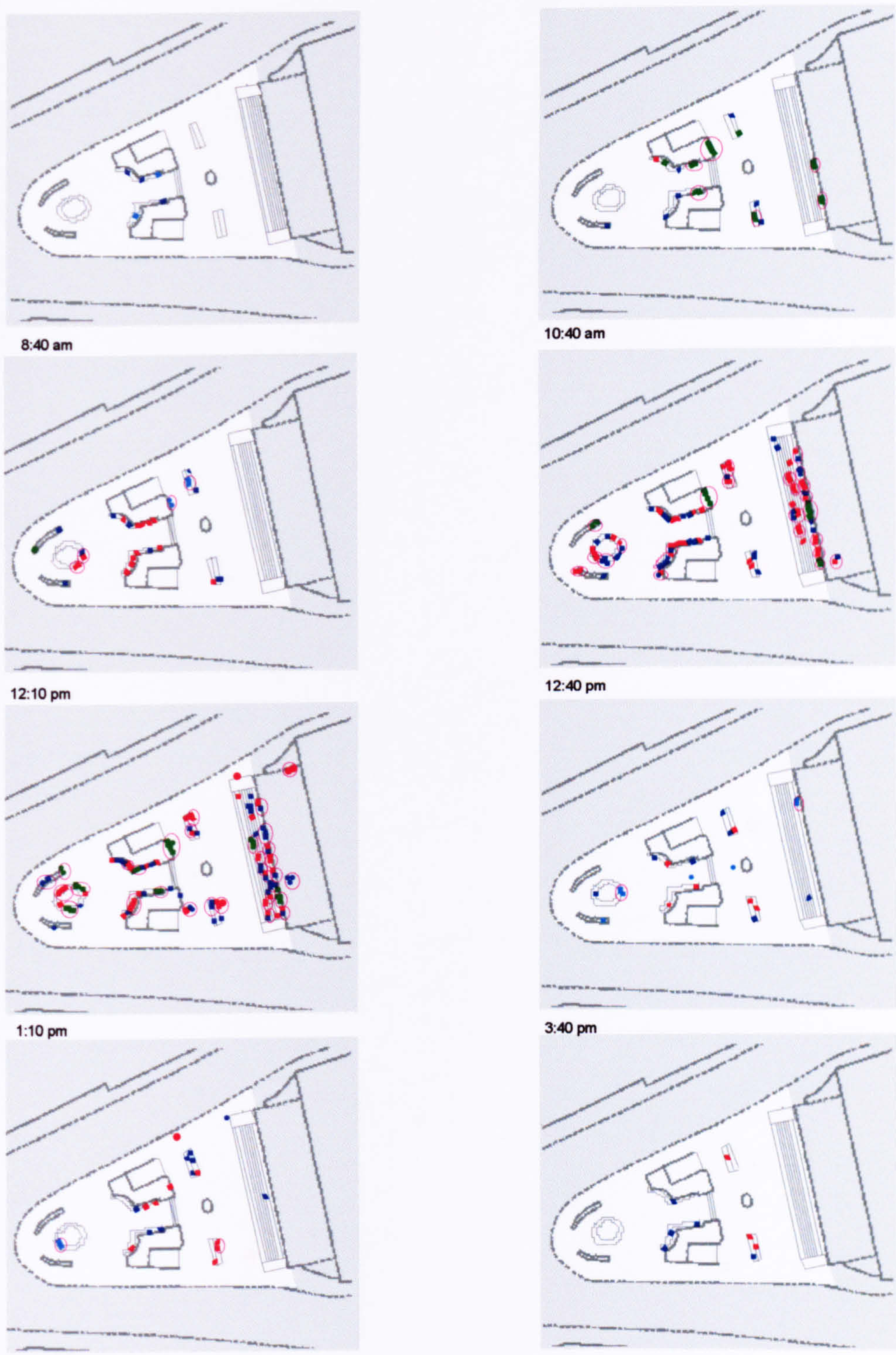
22nd August 96, mean temperature = 17.8 C, overcastted with sunny spels

City worker male
City worker female
office smokers
tourists
others

talking
sitting
standing
* no one observed

Plate 6.10. Pattern of static people distribution: Bank Corner (1/2)

scale: 1:1200



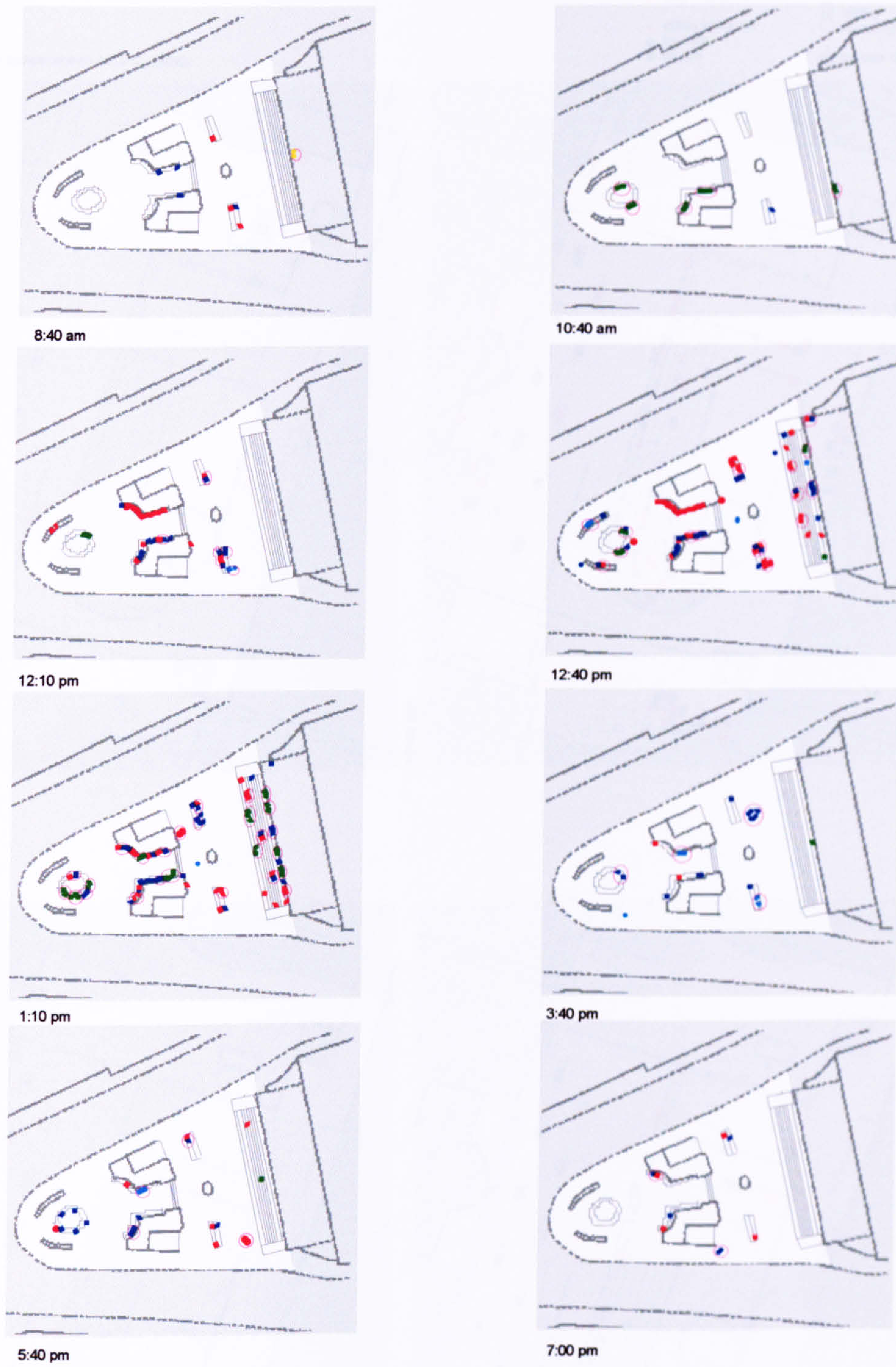
17th July 96, mean temperature = 16.8 C, sunny

- City worker male
- City worker female
- office smokers
- tourists
- others

talking
sitting
standing
* no one observed

Plate 6.10. Pattern of static people distribution: Bank Corner (2/2)

scale: 1:1200



- City worker male
- City worker female
- office smokers
- tourists
- others

talking
sitting
standing
* no one observed

19th July 96, mean temperature = 19.1 C, sunny

Plate 6.11. Pattern of static people distribution: Exchange Square (1/6)

scale: 1:1200

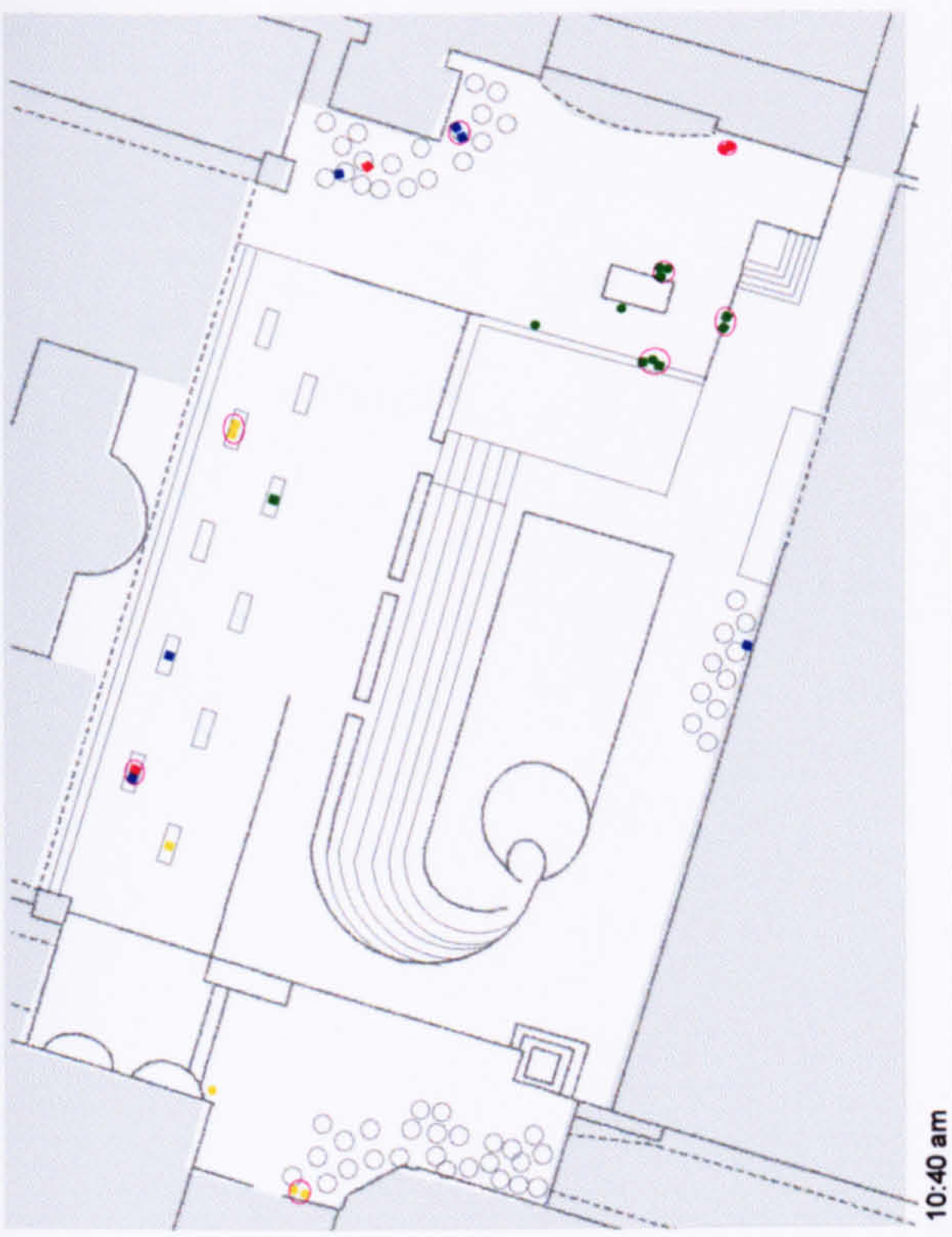
- City worker male
- City worker female
- office smokers
- tourists
- others

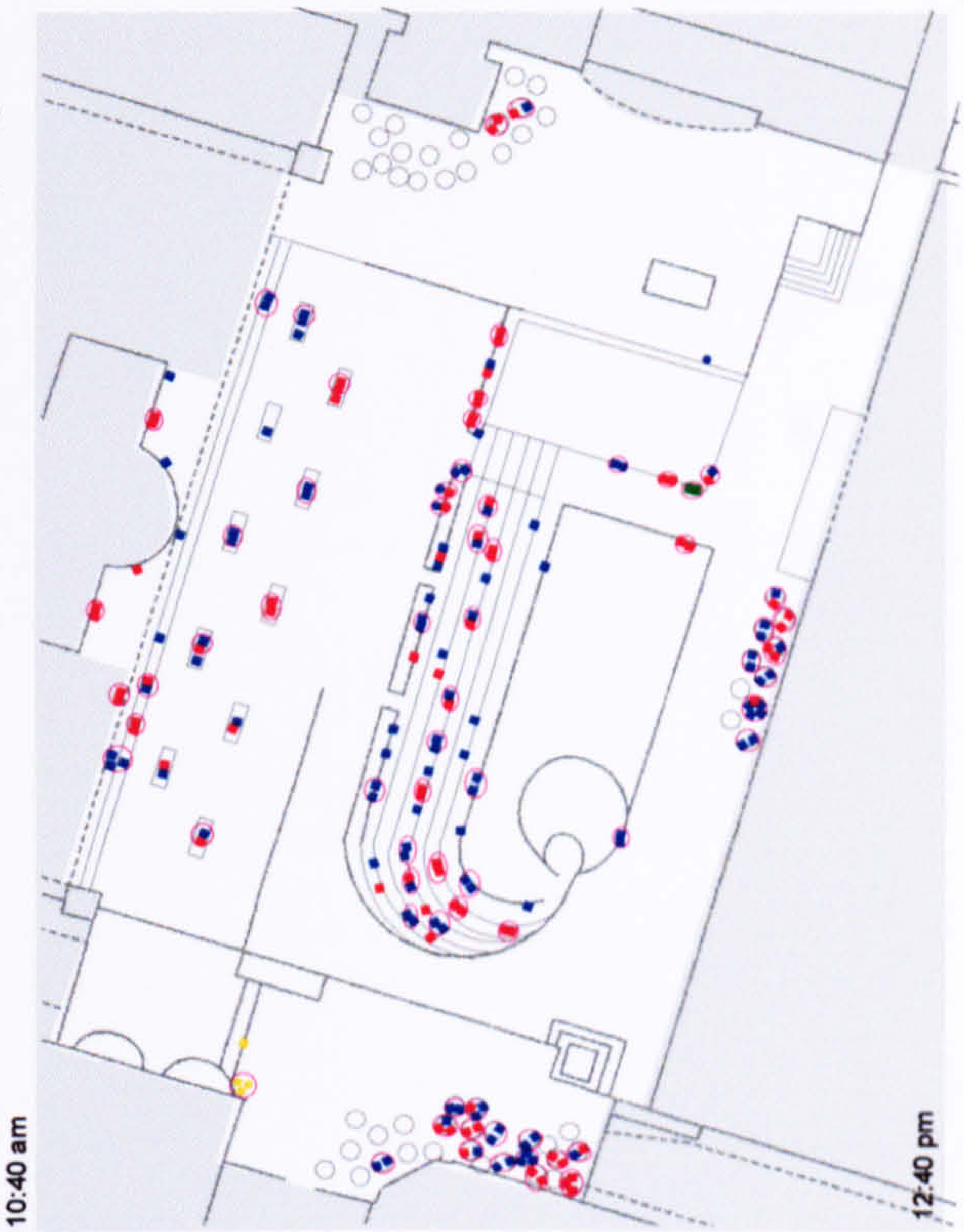
talking

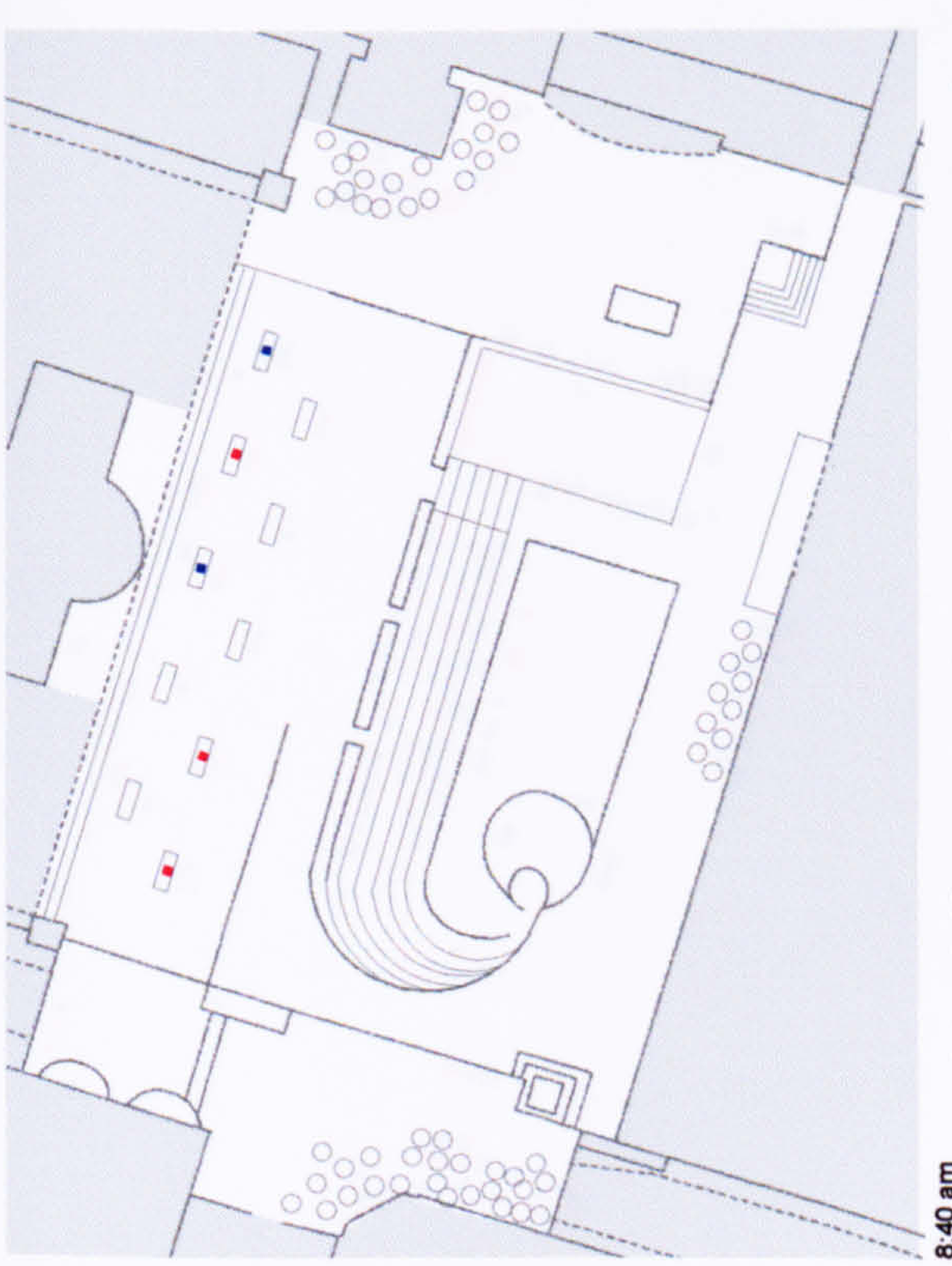
sitting
standing

✱ no one observed

30 July 96, mean temperature= 19.5 C, cloudy







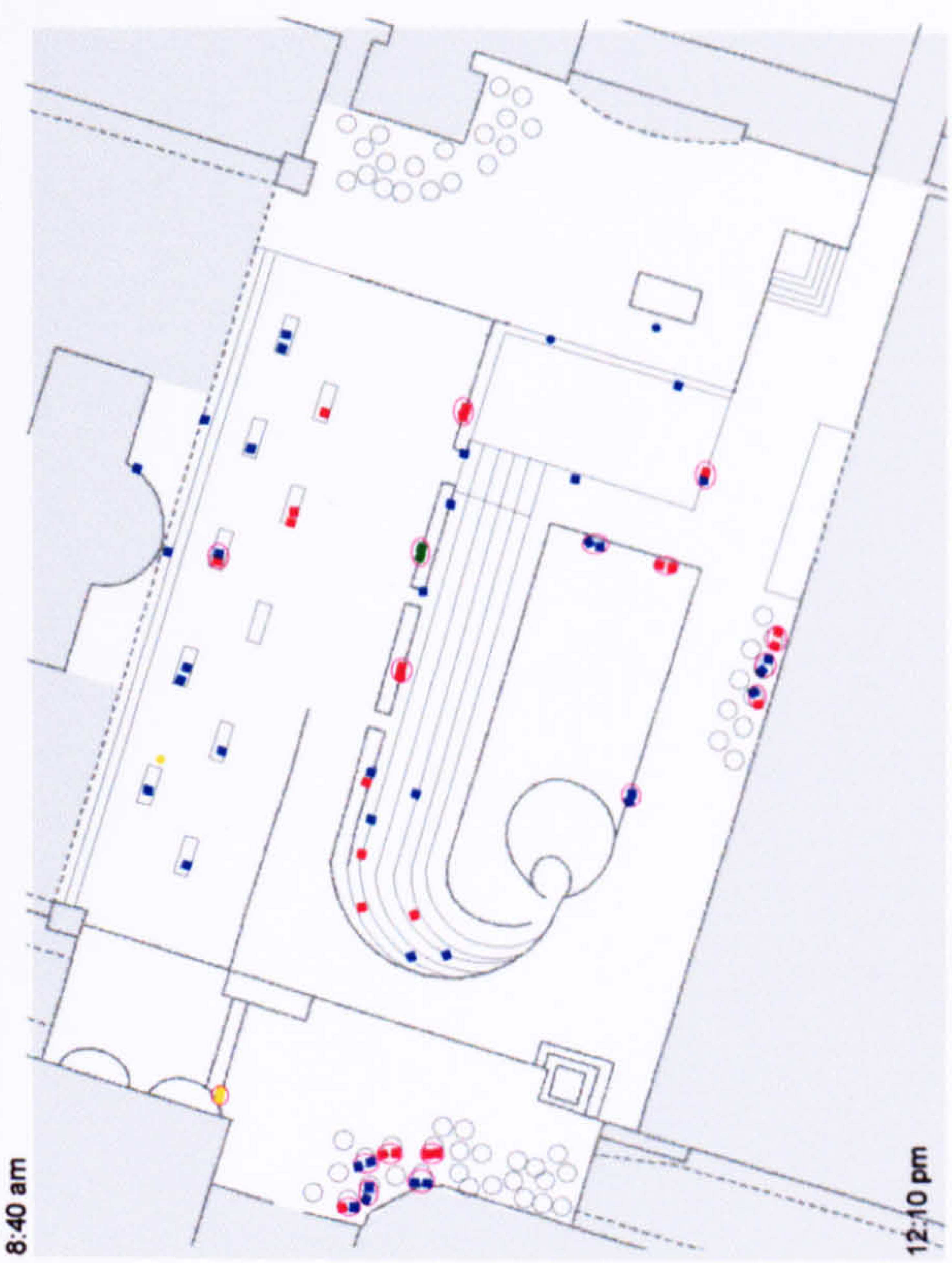


Plate 6.11. Pattern of static people distribution: Exchange Square (2/6)

scale: 1:1200

- City worker male
- City worker female
- office smokers
- tourists
- others
- talking
- sitting
- standing
- no one observed

30th July 96, mean temperature = 19.5 C, cloudy

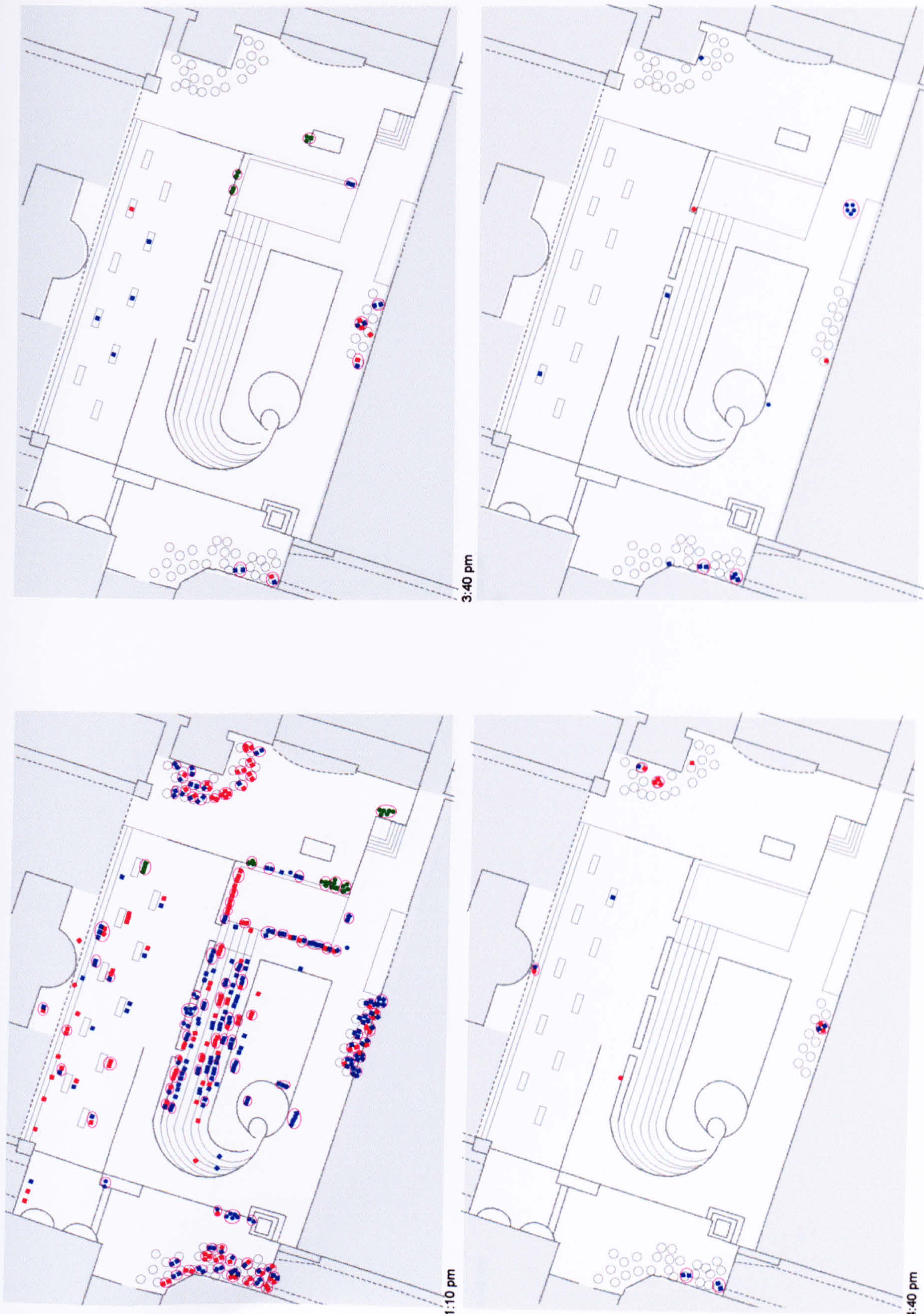


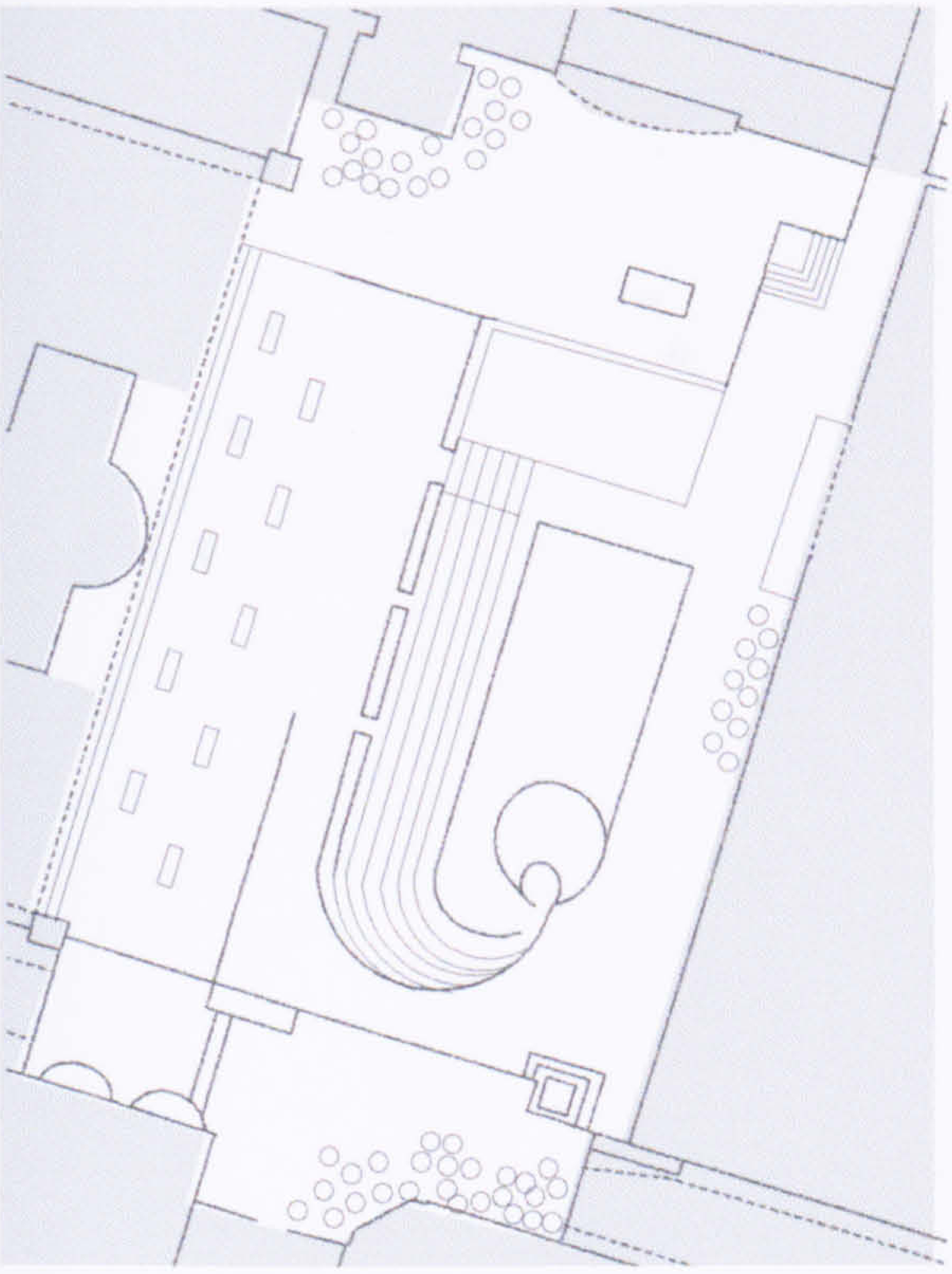
Plate 6.11. Pattern of static people distribution: Exchange Square (3/6)

scale: 1:1200

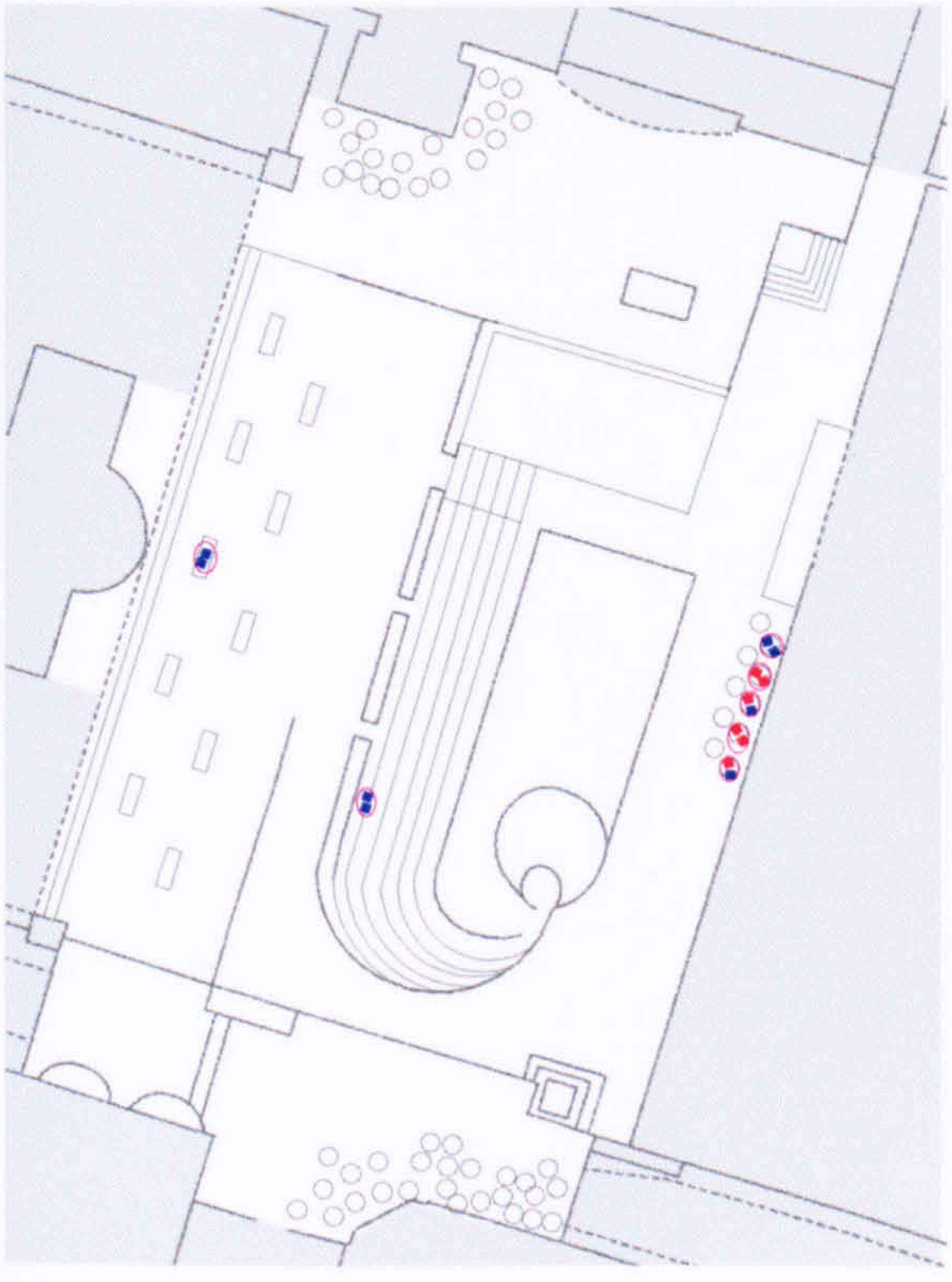
- City worker male
- City worker female
- office smokers
- tourists
- others

talking
sitting
standing
* no one observed

30th July 96, mean temperature = 19.5 C, cloudy



7:40 pm
*



6:40 pm

Plate 6.11. Pattern of static people distribution: Exchange Square (4/6)

scale: 1:1200

8th August 96, mean temperature = 17.6 C, cloudy

City worker male
City worker female
office smokers
tourists
others

talking
sitting
standing
* no one observed

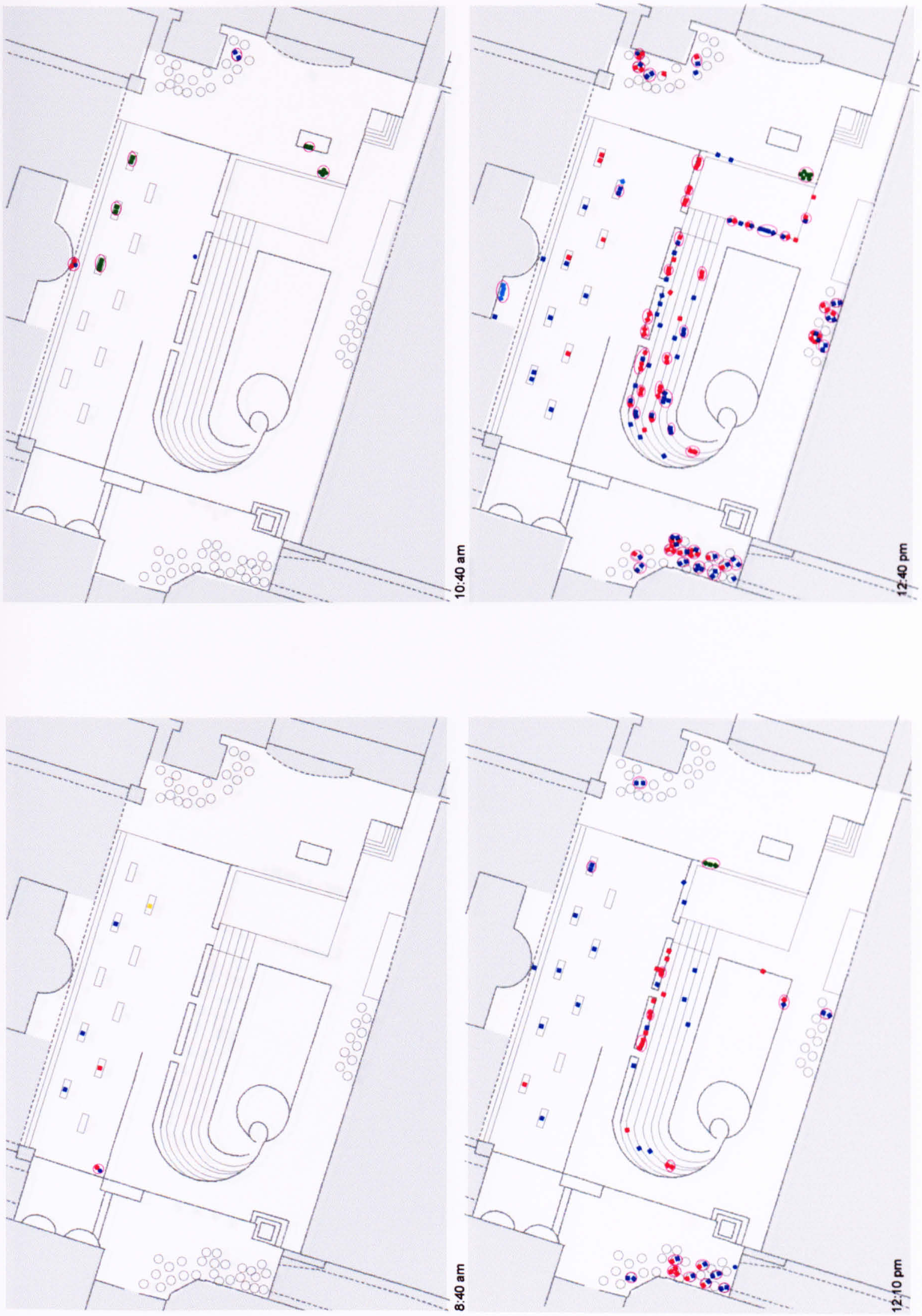


Plate 6.11. Pattern of static people distribution: Exchange Square (5/6)

scale: 1:1200

8th August 96, mean temperature = 17.6 C, cloudy

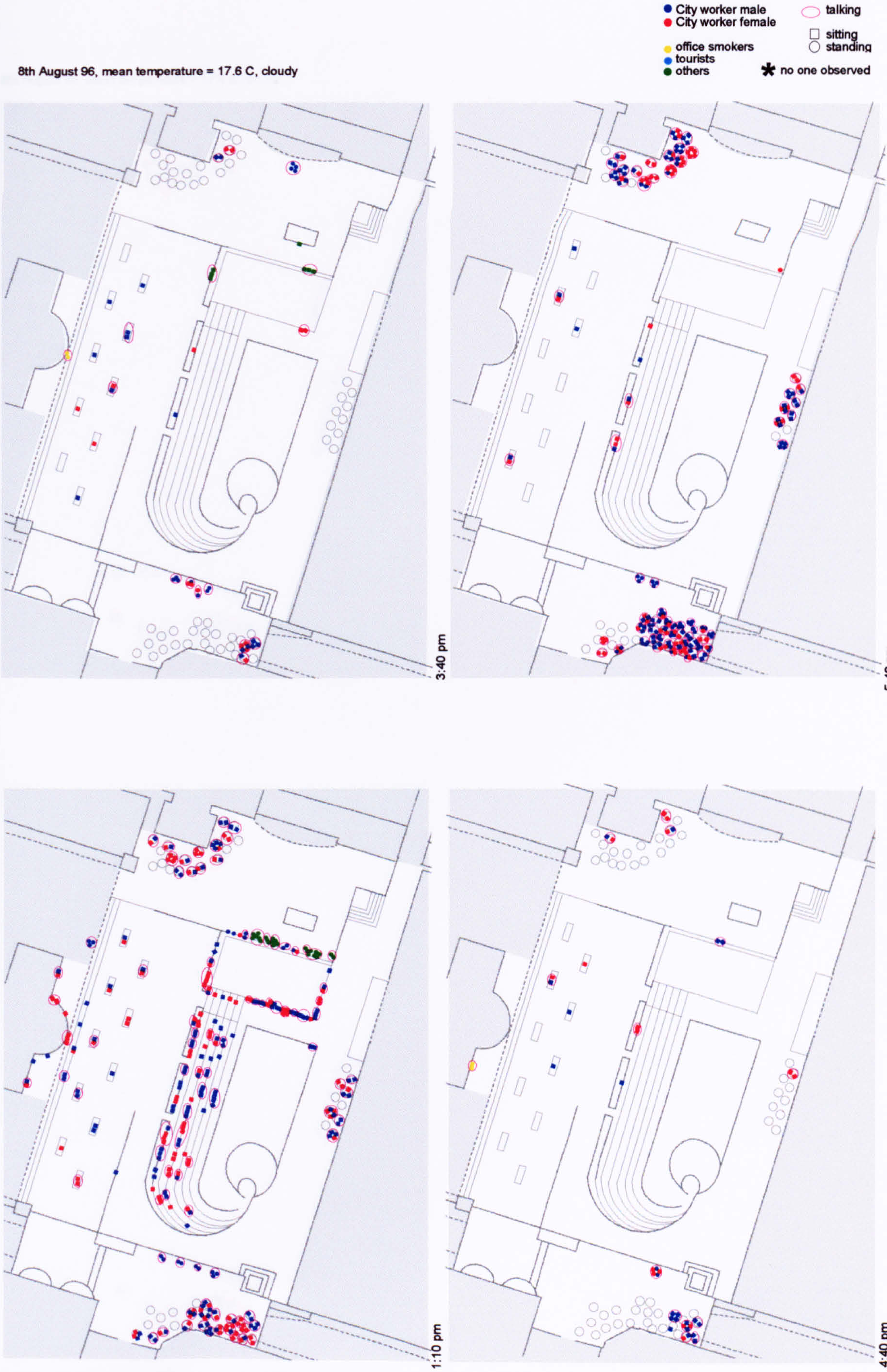
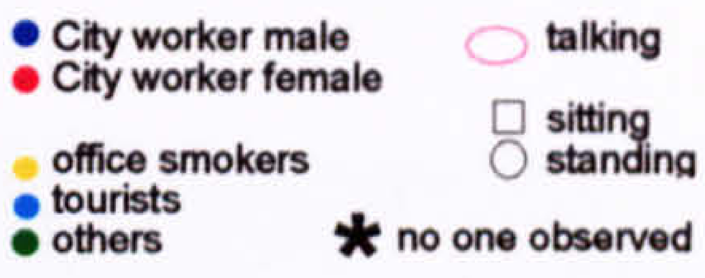


Plate 6.11. Pattern of static people distribution: Exchange Square (6/6)

scale: 1:1200



8th August 96, mean temperature = 17.6 C, cloudy

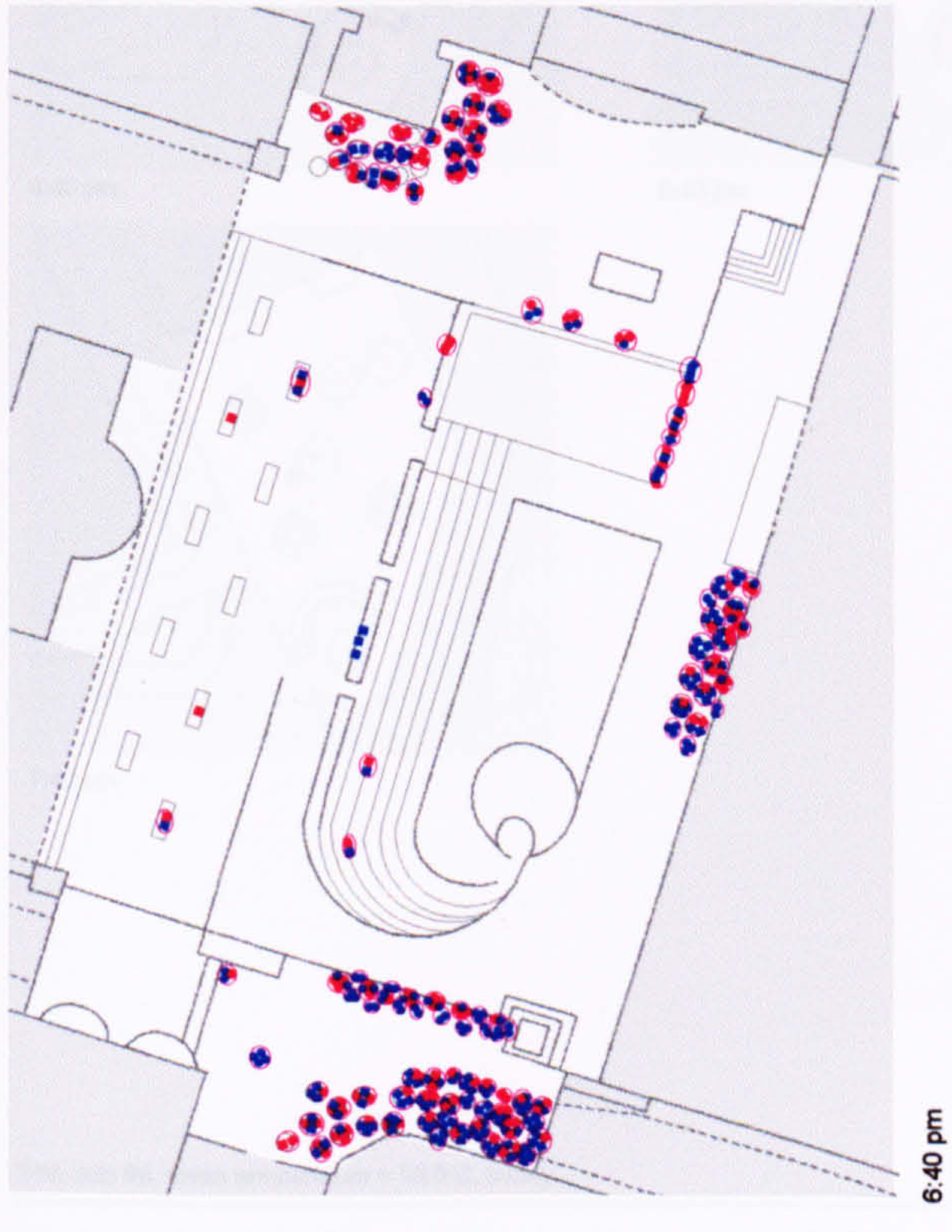
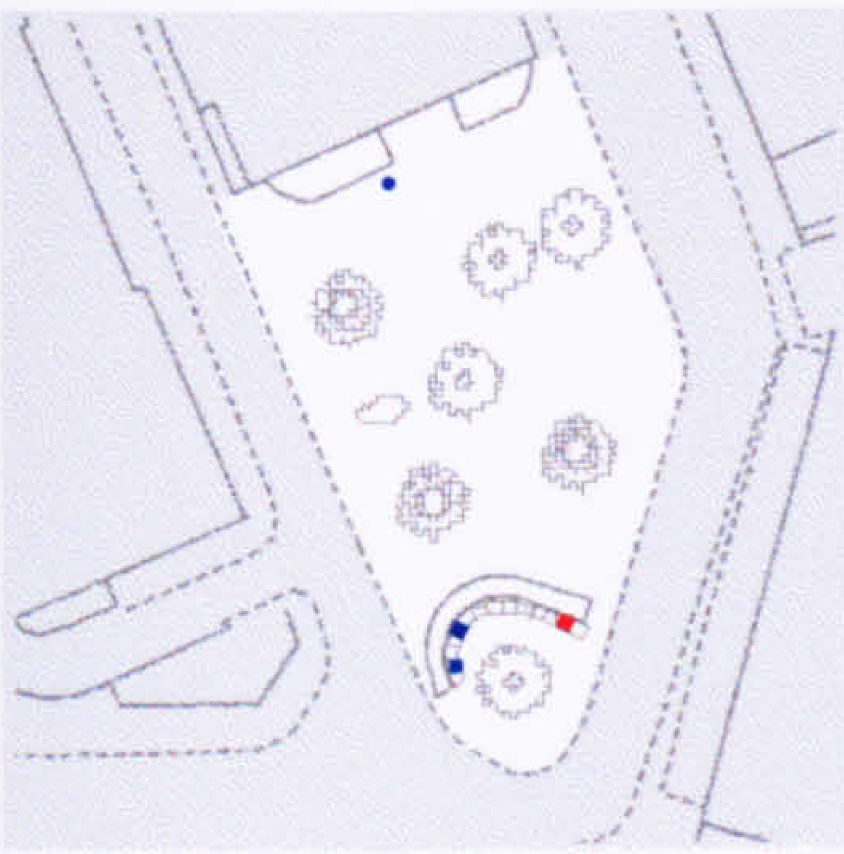
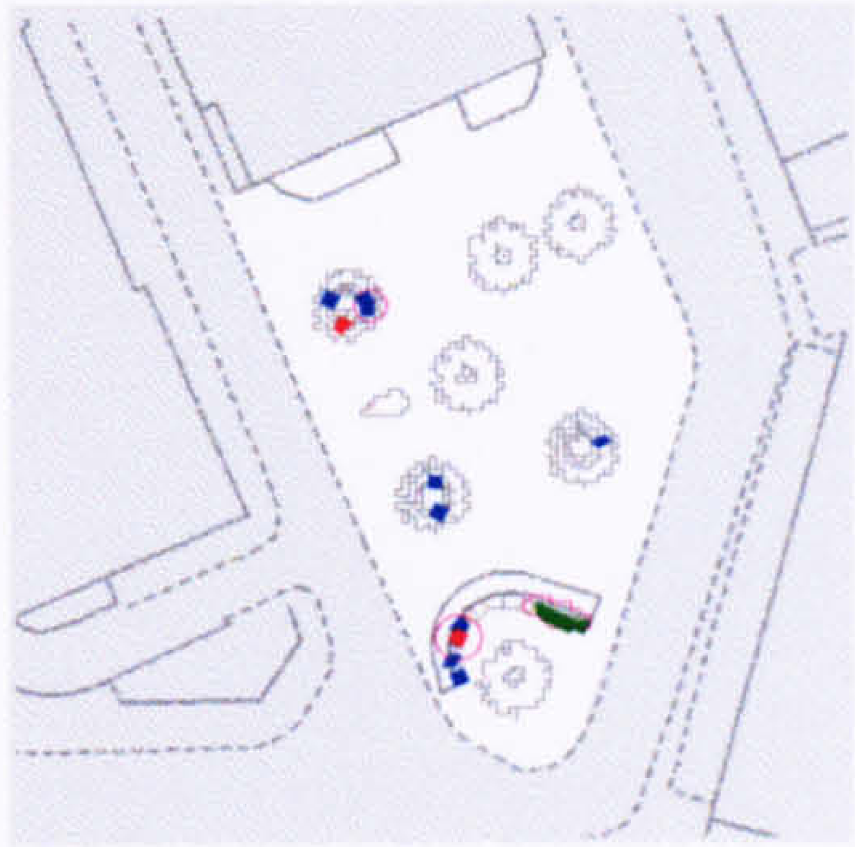


Plate 6.12. Pattern of static people distribution: Fenchurch Place (1/2)

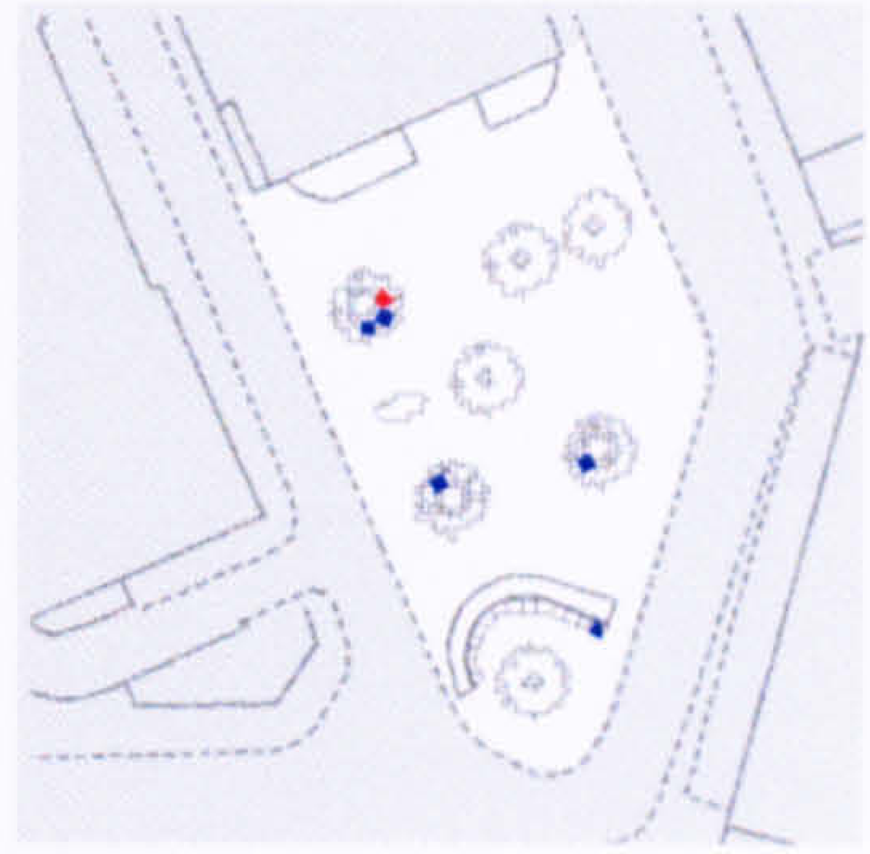
scale: 1:1200



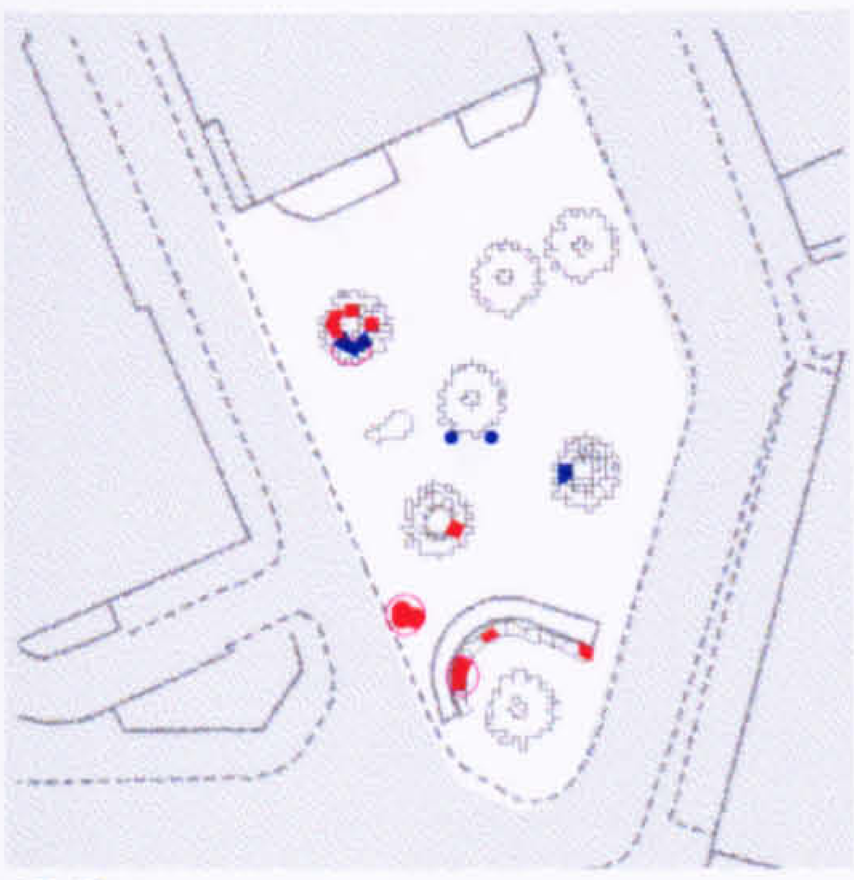
8:40 am



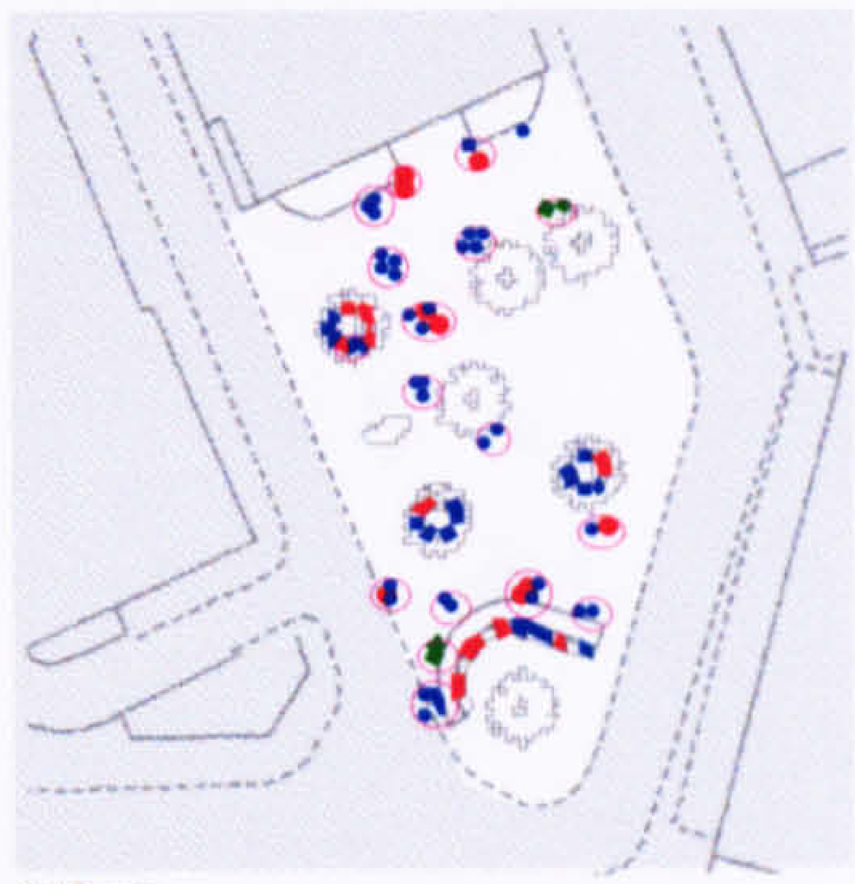
10:40 am



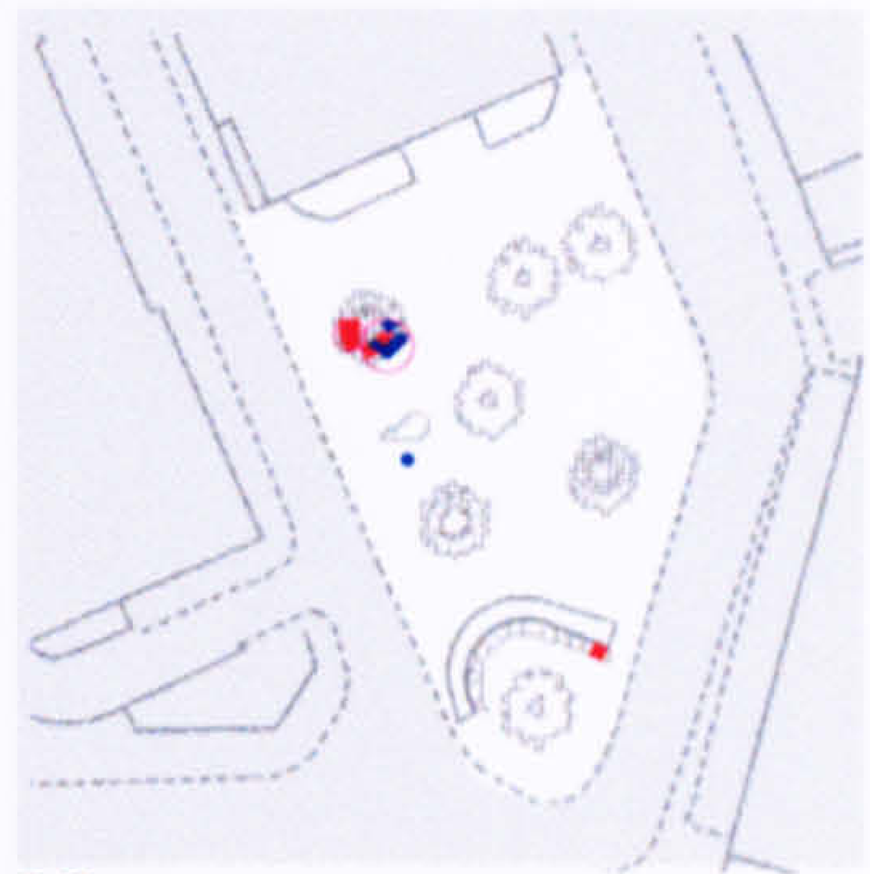
12:10 pm



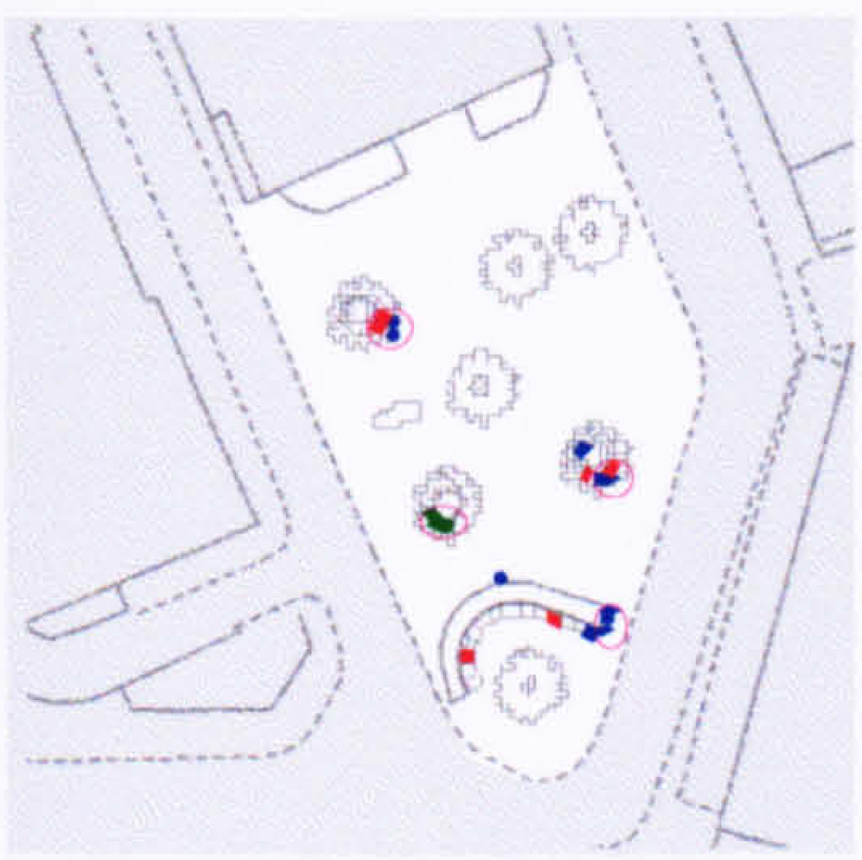
12:40 pm



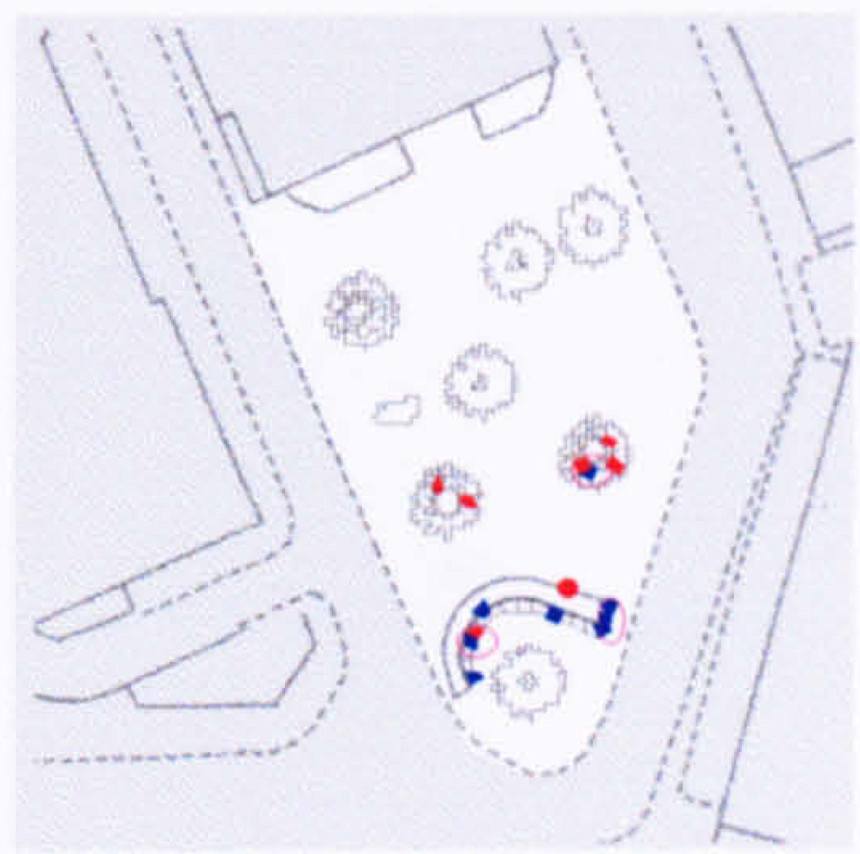
1:10 pm



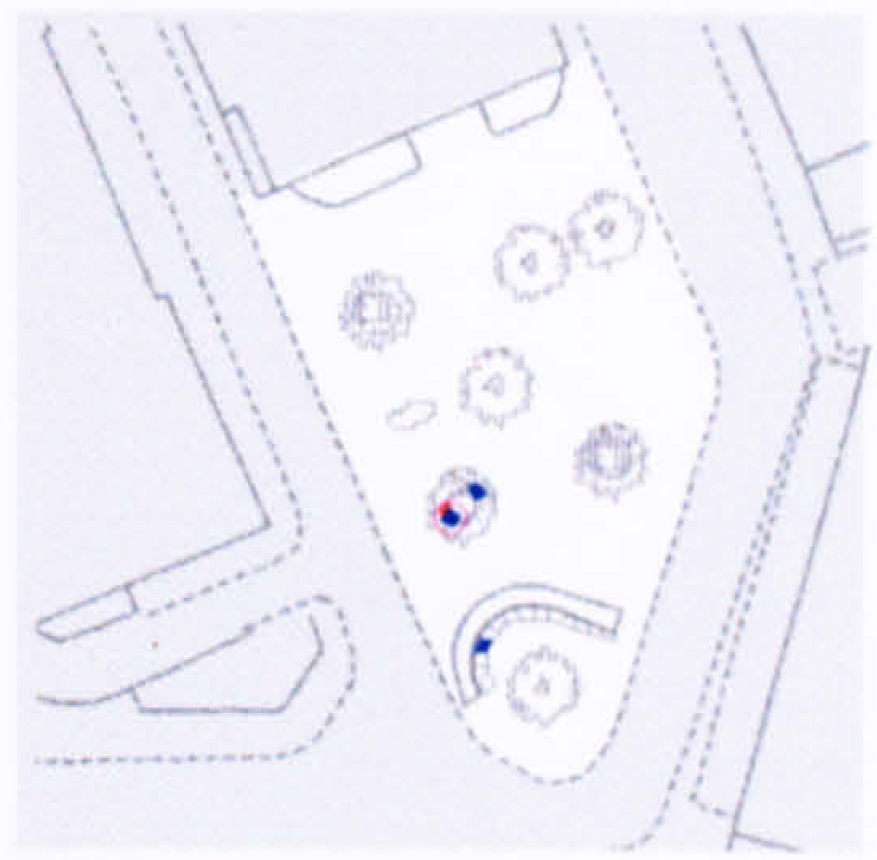
3:40 pm



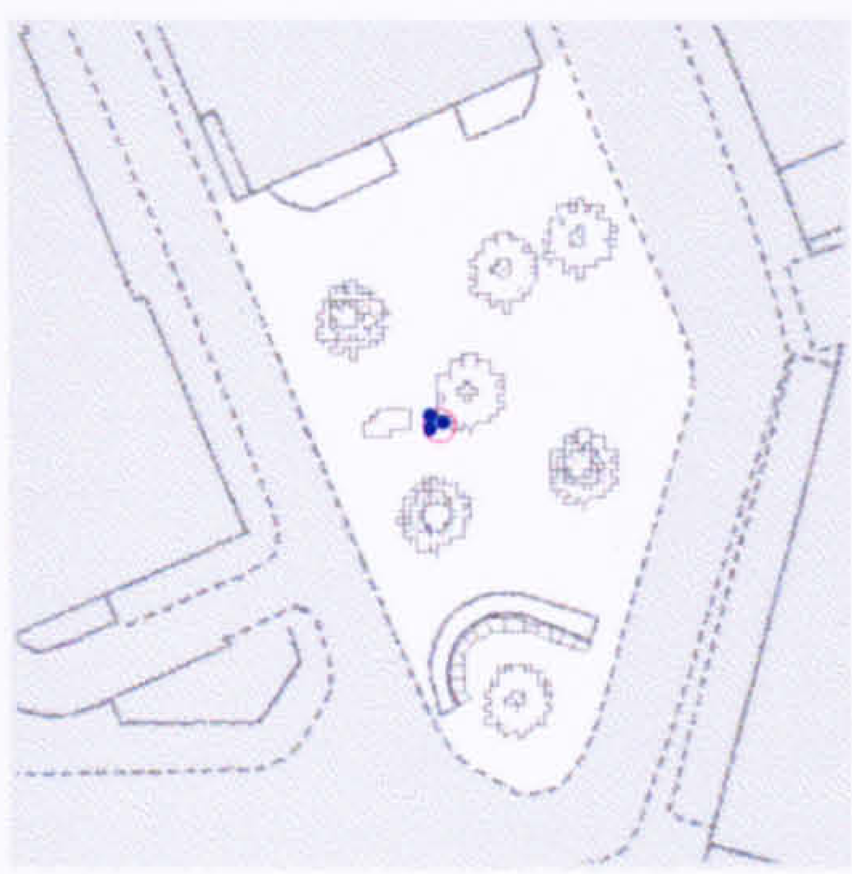
4:40 pm



5:40 pm



6:40 pm



7:40 pm

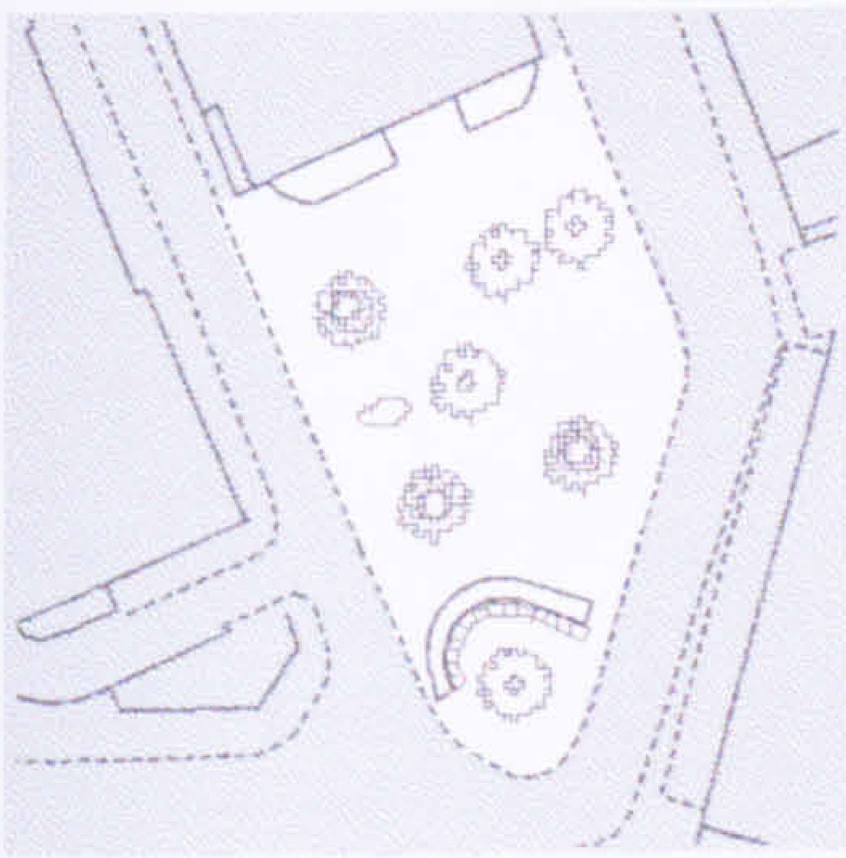
31th July 96, mean temperature = 19.6 C, sunny

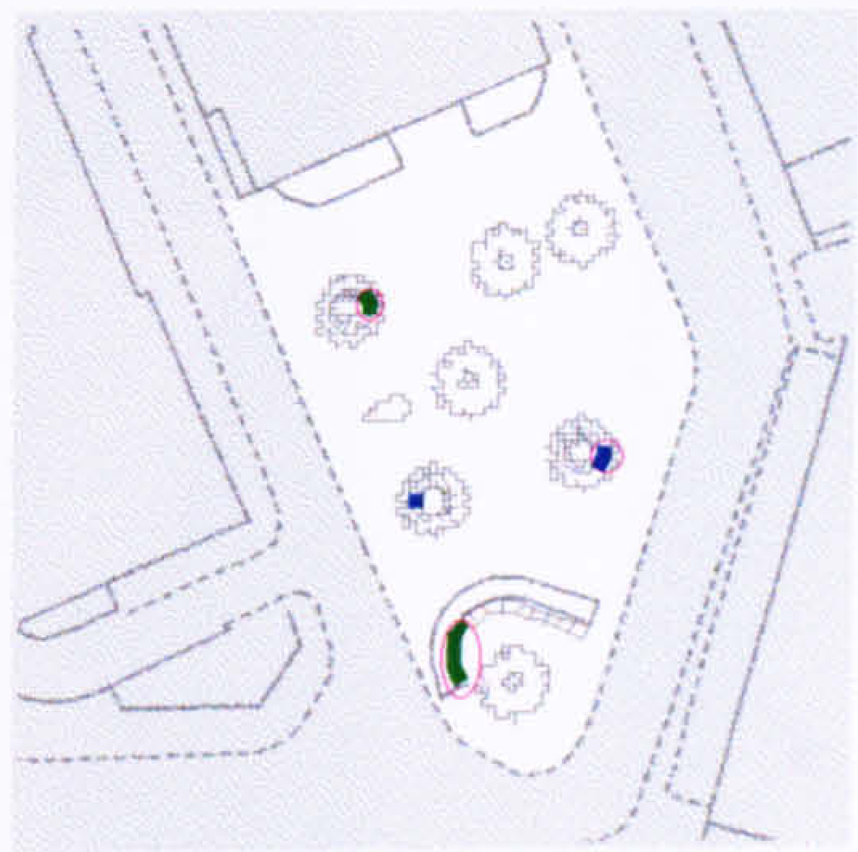
● City worker male
● City worker female
● office smokers
● tourists
● others

talking
sitting
standing
* no one observed

Plate 6.12. Pattern of static people distribution: Fenchurch Place (2/2)

scale: 1:1200


8:40 am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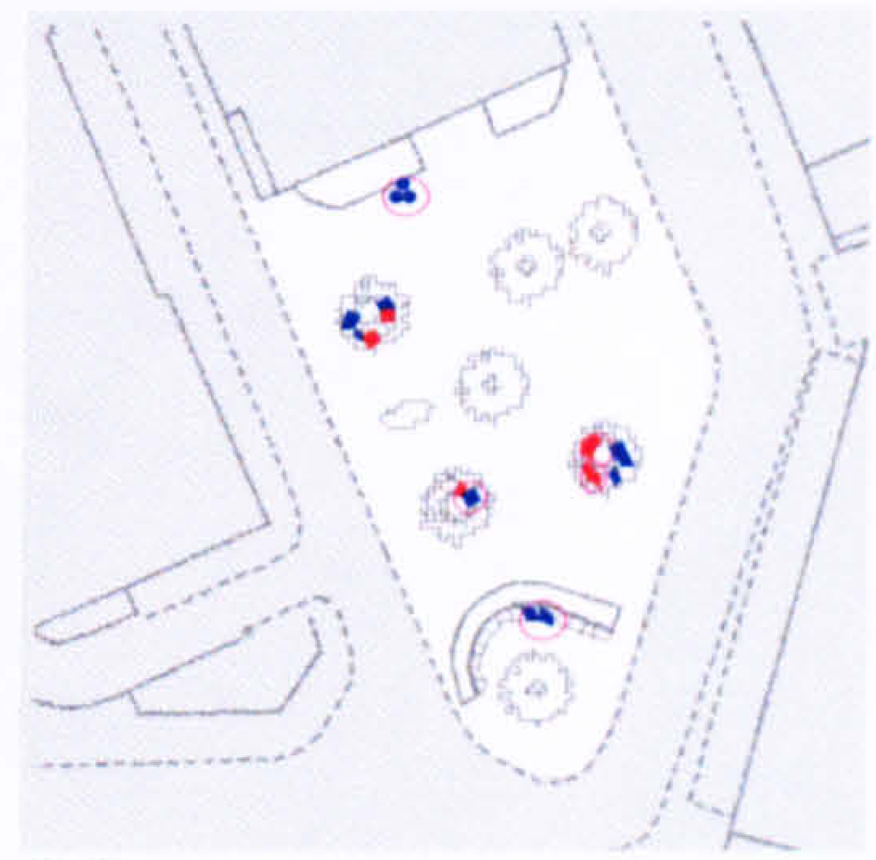
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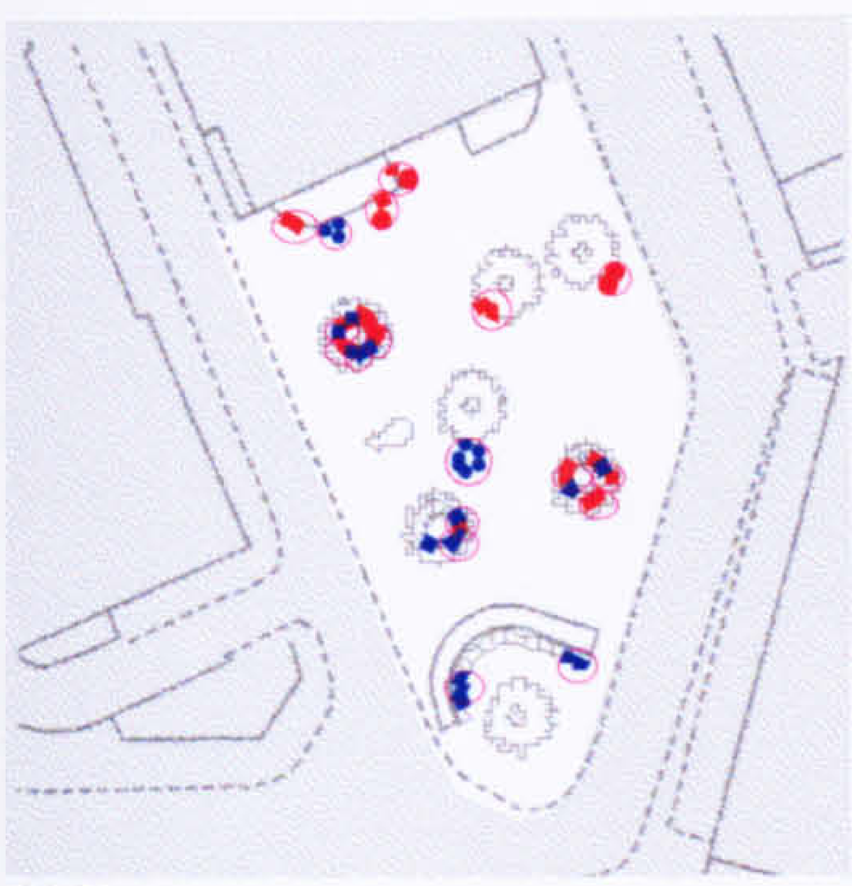
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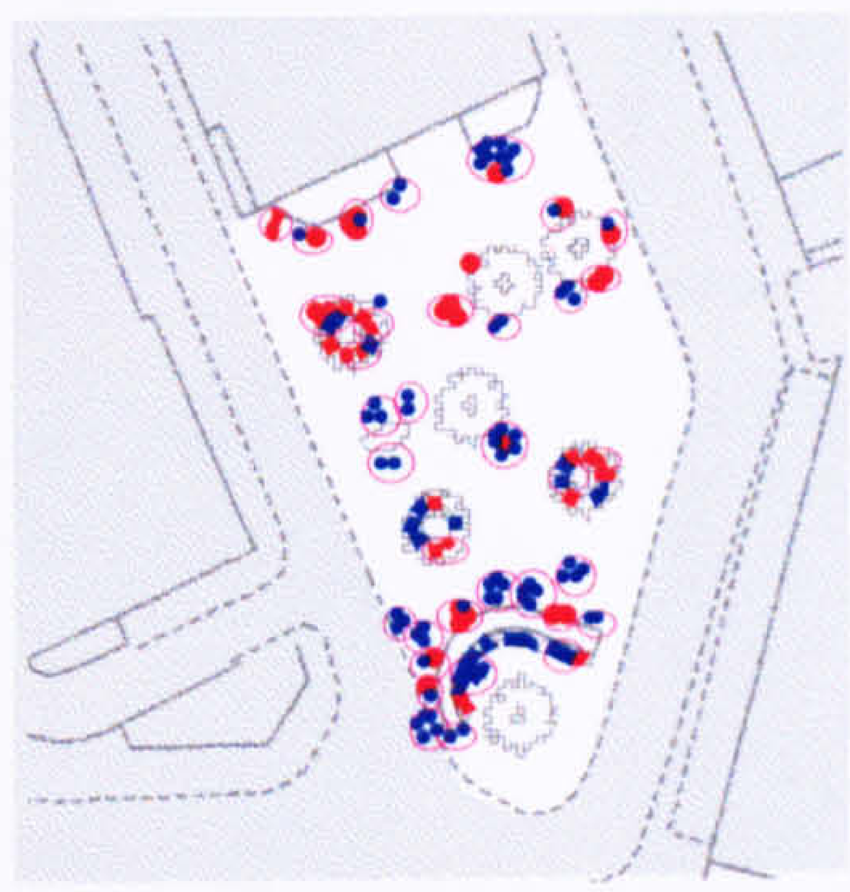
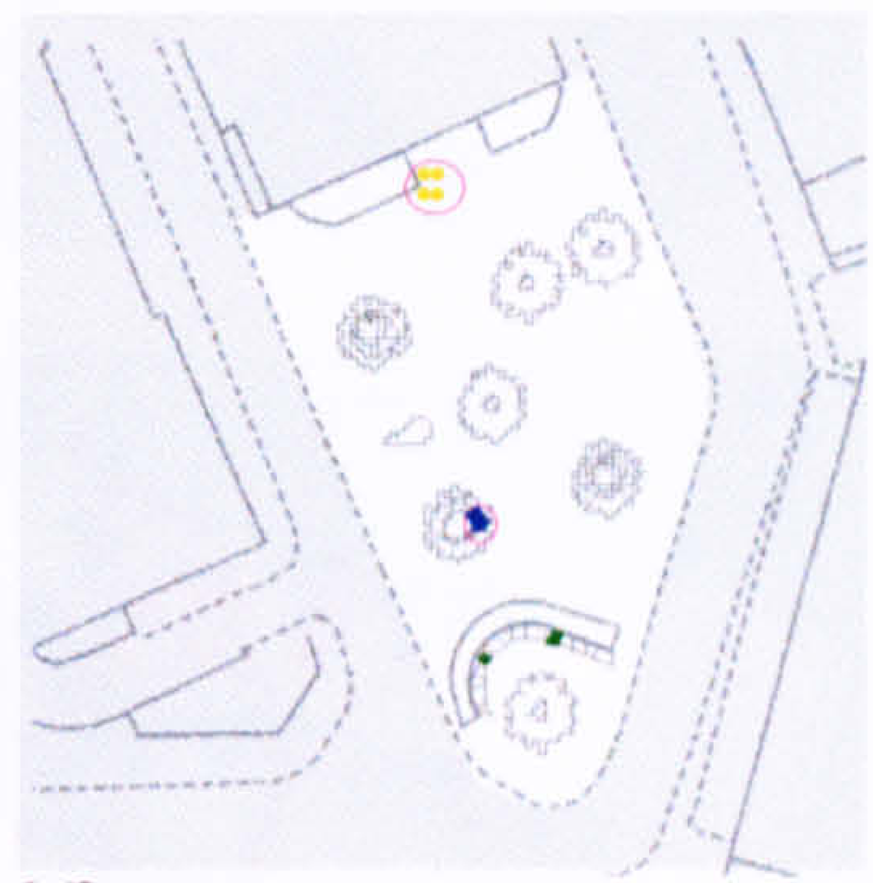
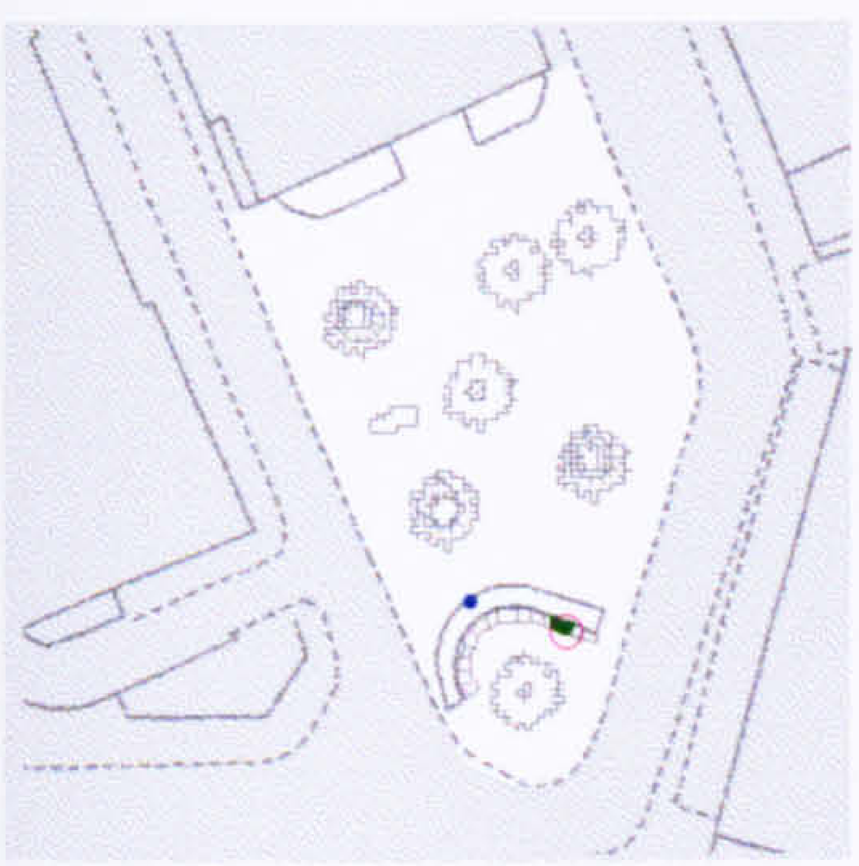
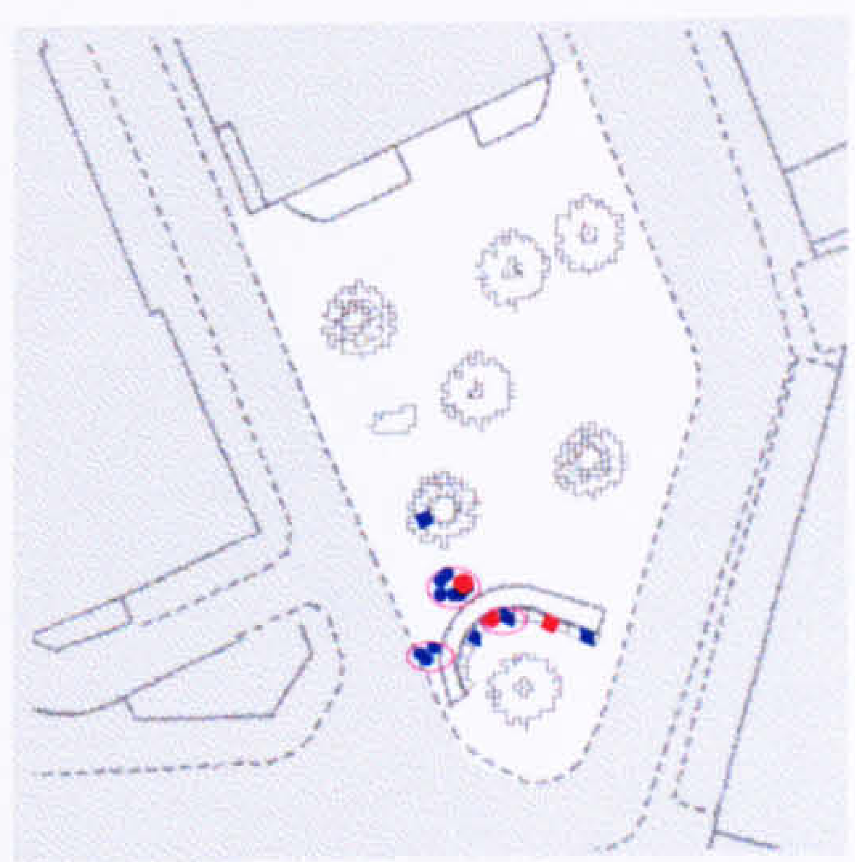
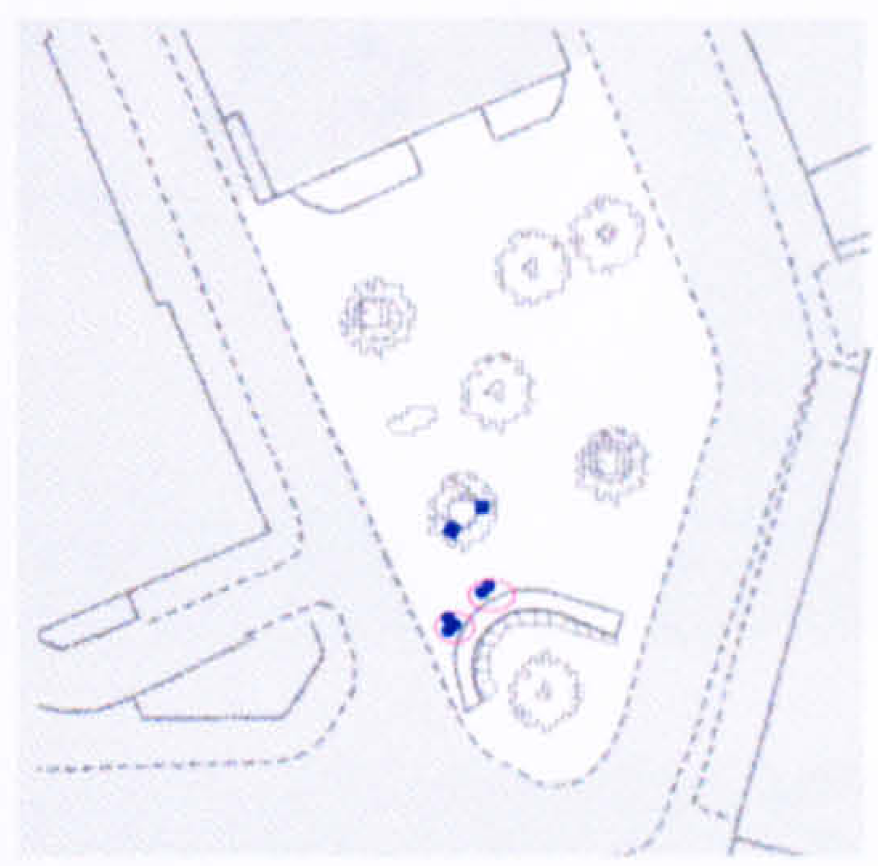
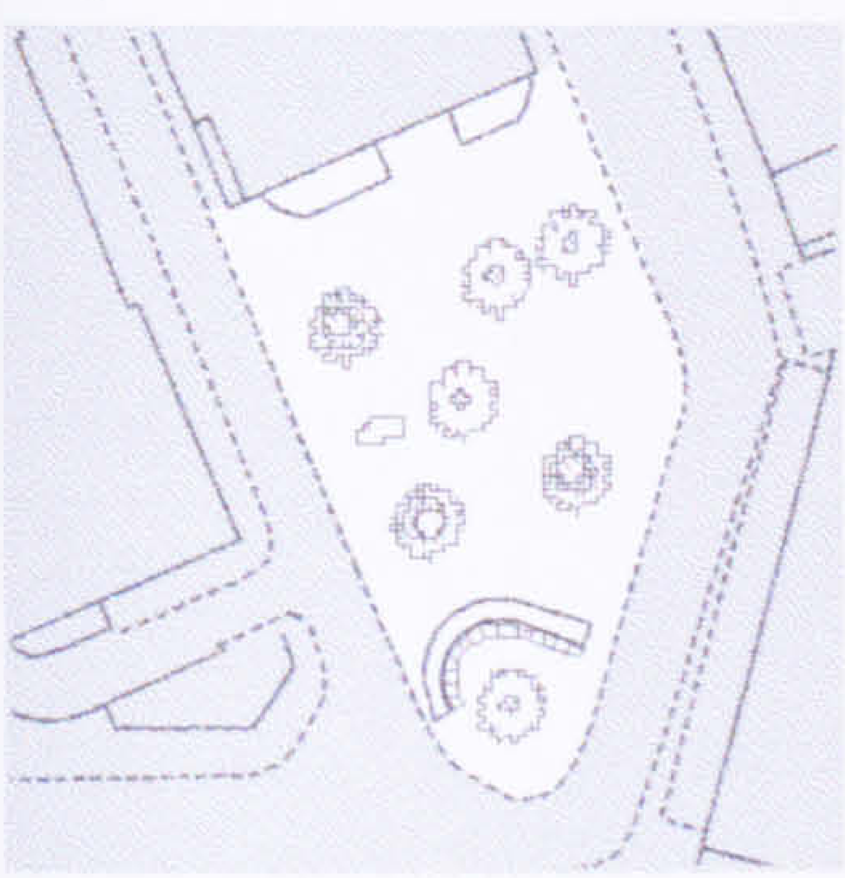

1:10 pm


3:40 pm


4:40 pm


5:40 pm


6:40 pm


7:40 pm
*

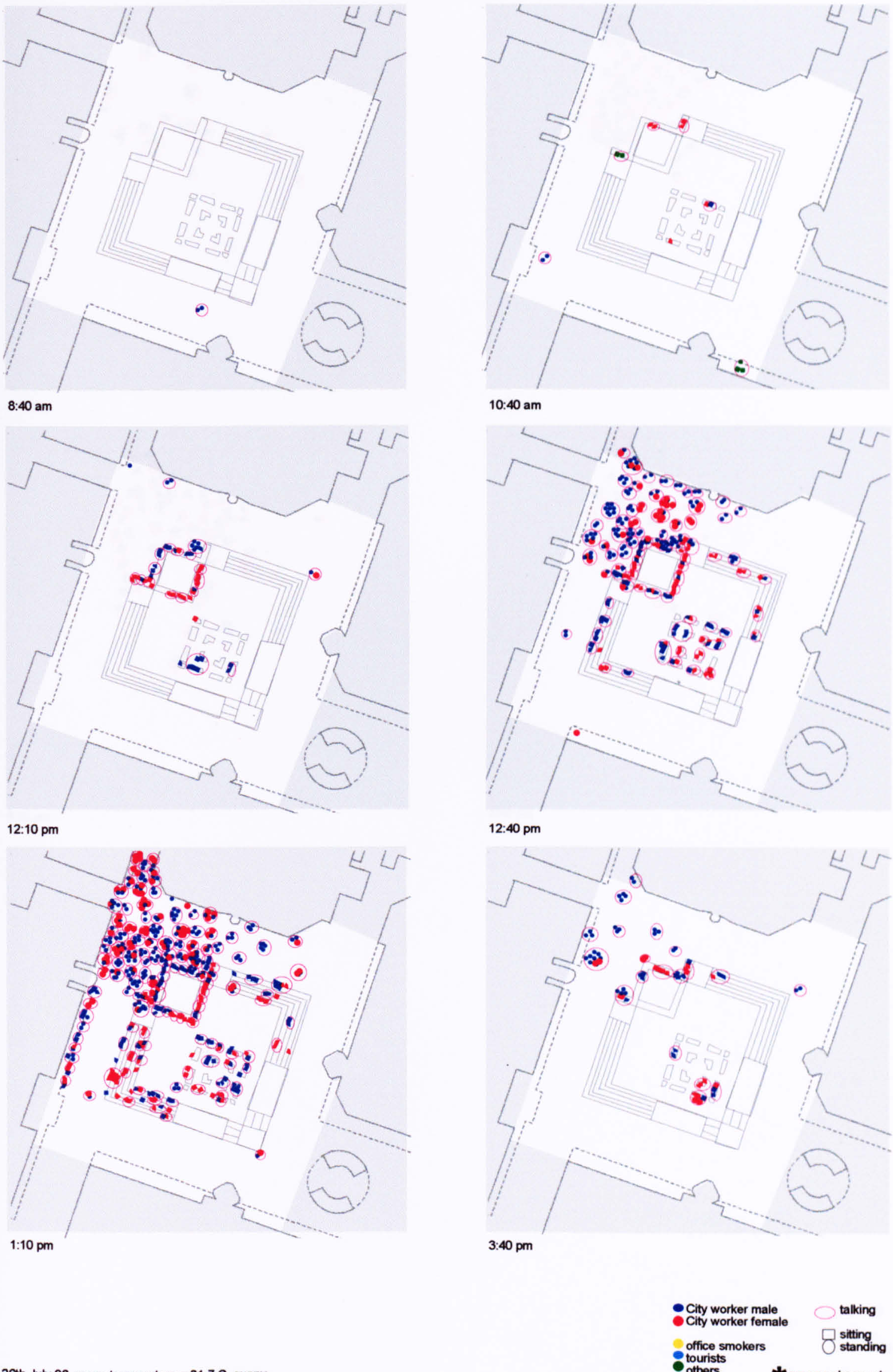
8th August 96, mean temperature = 17.6 C, cloudy

● City worker male
● City worker female
● office smokers
● tourists
● others

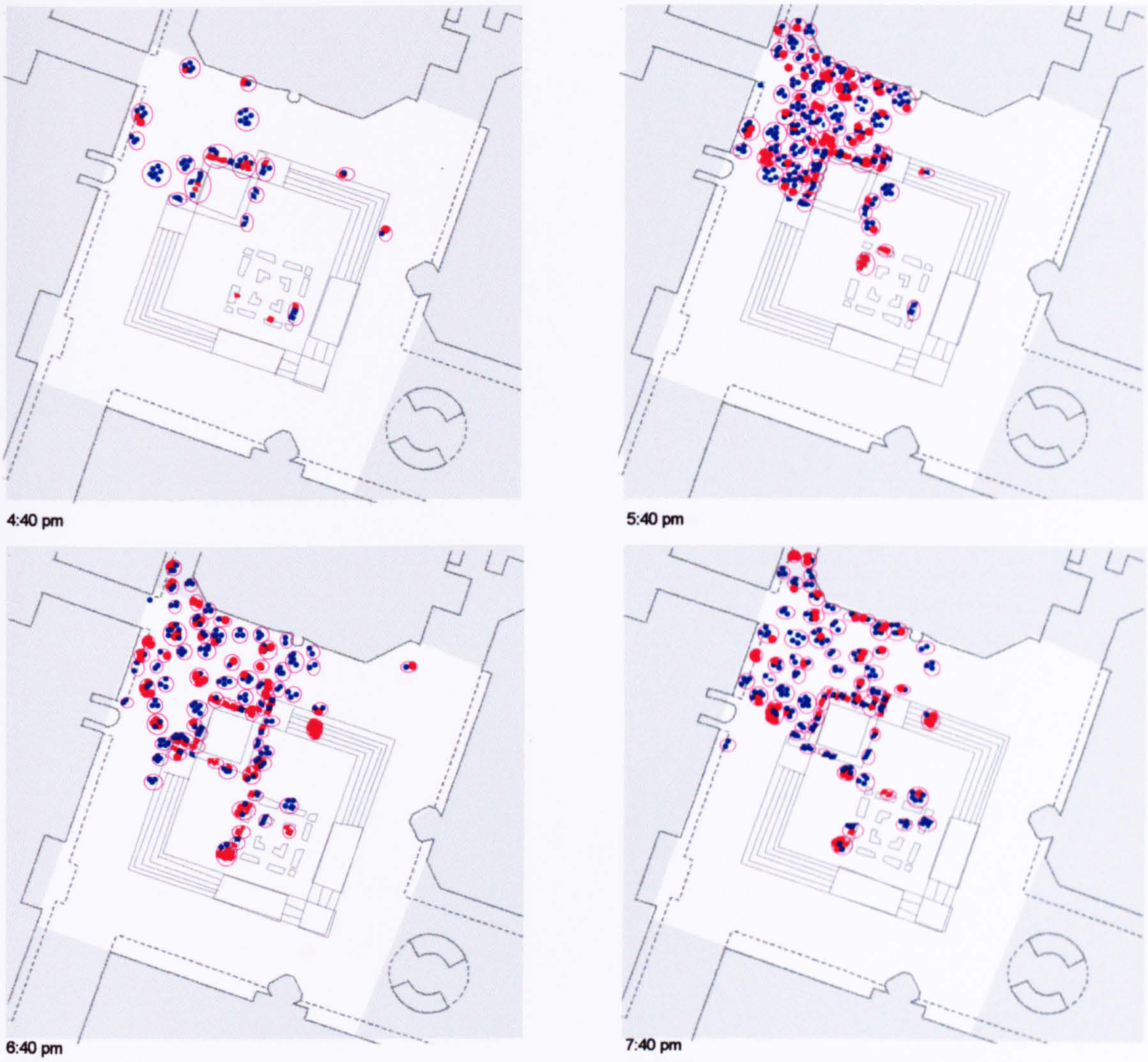
talking
sitting
standing
* no one observed

Plate 6.13. Pattern of static people distribution: Finsbury Av. (1/4)

scale: 1:1200



26th July 96, mean temperature = 21.7 C, sunny

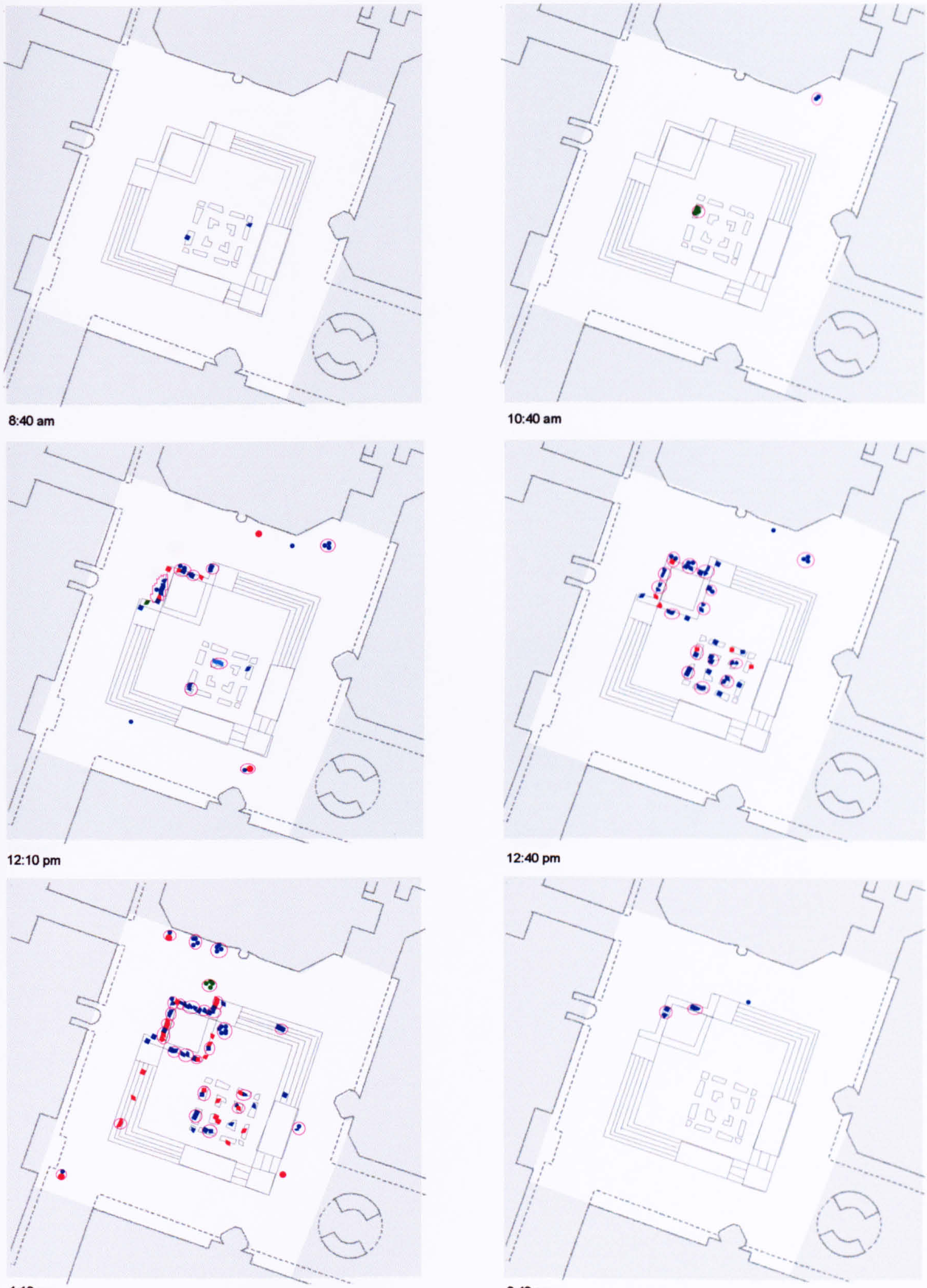


● City worker male
● City worker female
● office smokers
● tourists
● others
talking
sitting
standing
* no one observed

26th July 96, mean temperature = 21.7 C, sunny

Plate 6.13. Pattern of static people distribution: Finsbury Av. (3/4)

scale: 1:1200



8:40 am

10:40 am

12:10 pm

12:40 pm

1:10 pm

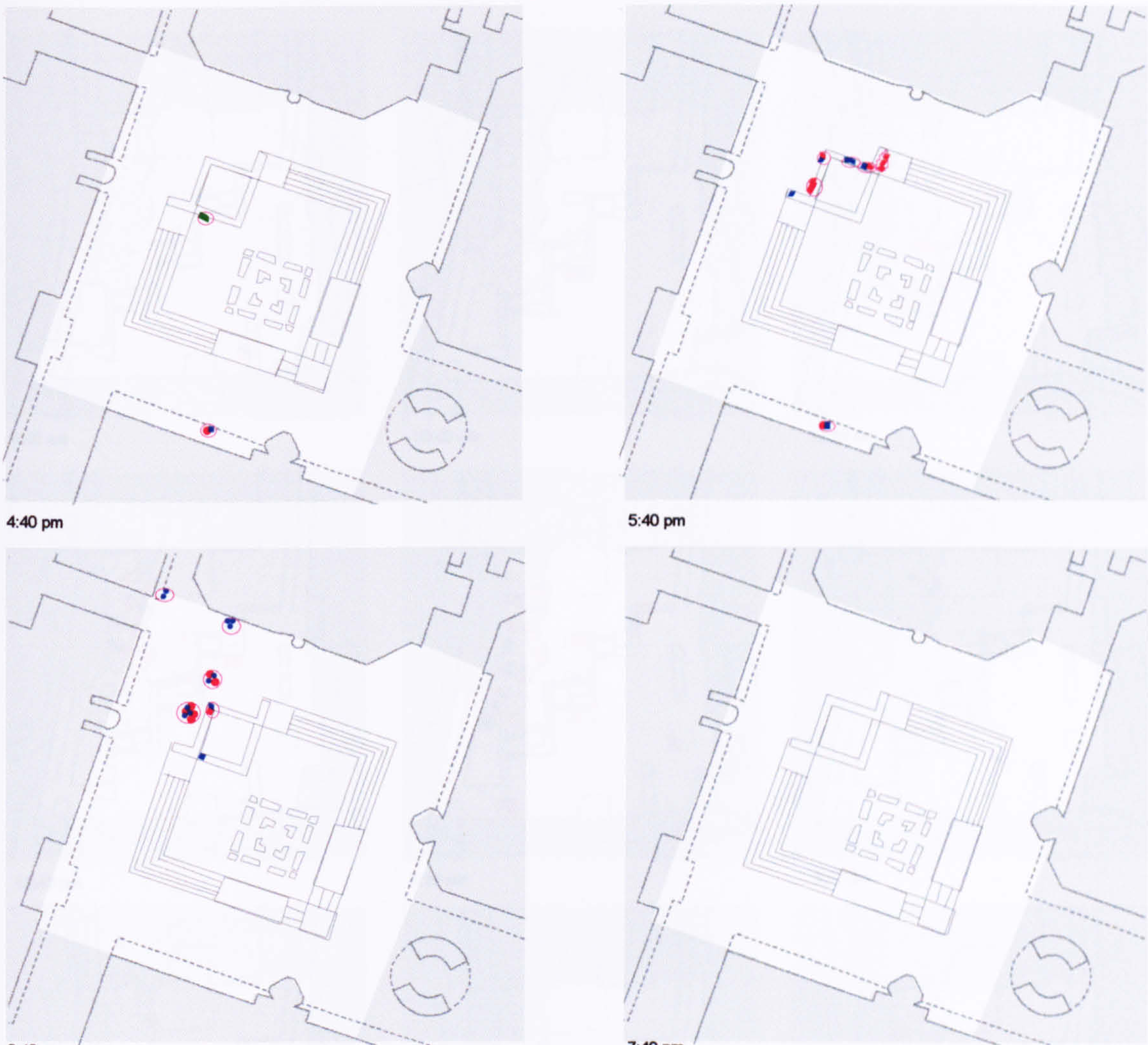
3:40 pm

- City worker male
- City worker female
- office smokers
- tourists
- others
- talking
- sitting
- standing
- ✱ no one observed

30th July 96, mean temperature = 19.5 C, cloudy

Plate 6.13. Pattern of static people distribution: Finsbury Av. (4/4)

scale: 1:1200



4:40 pm

5:40 pm

6:40 pm

7:40 pm
*

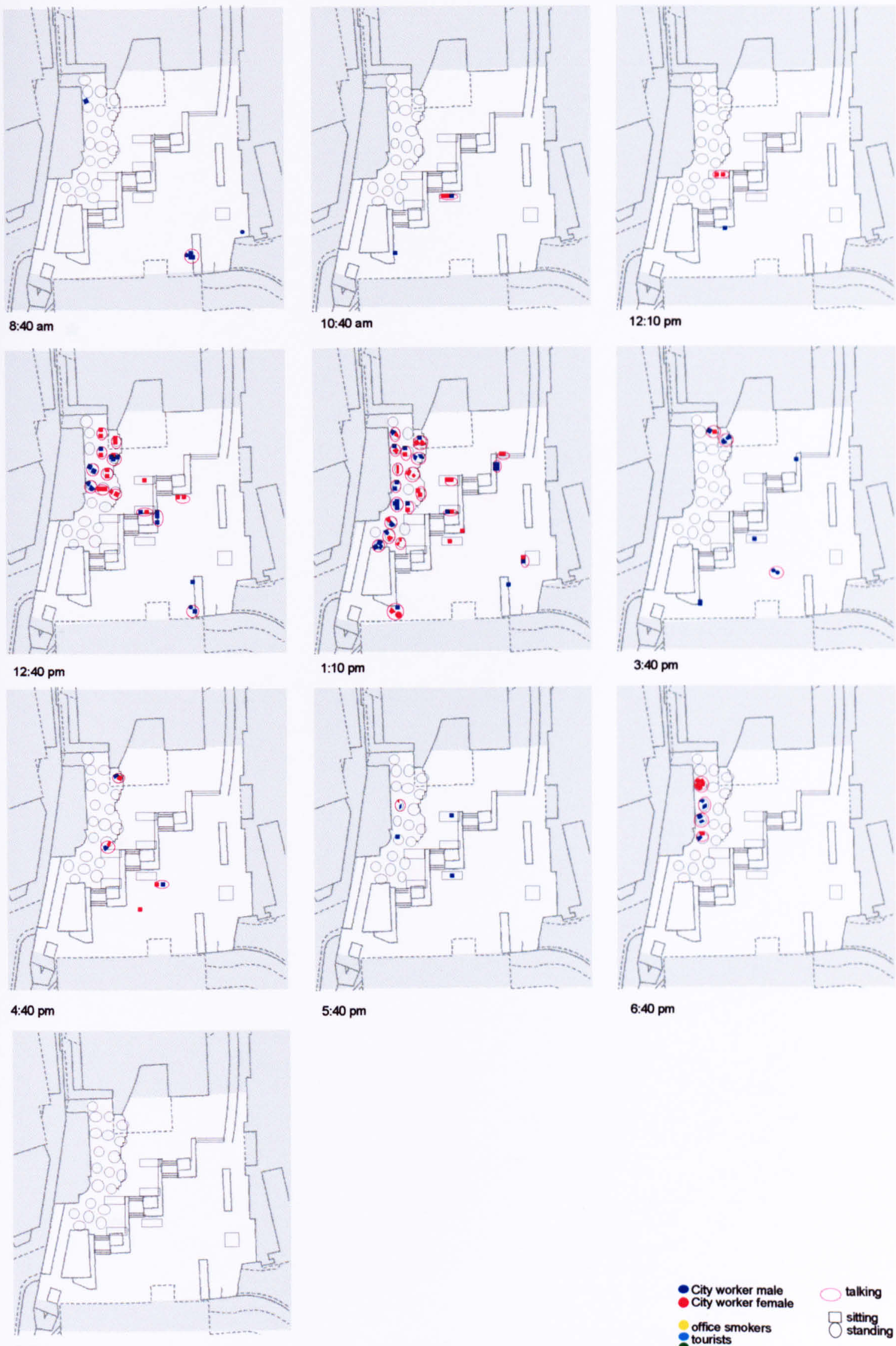
● City worker male
● City worker female
● office smokers
● tourists
● others

talking
sitting
standing
* no one observed

30th July 96, mean temperature = 19.5 C, cloudy

Plate 6.14. Pattern of static people distribution: Fleet Place (1/2)

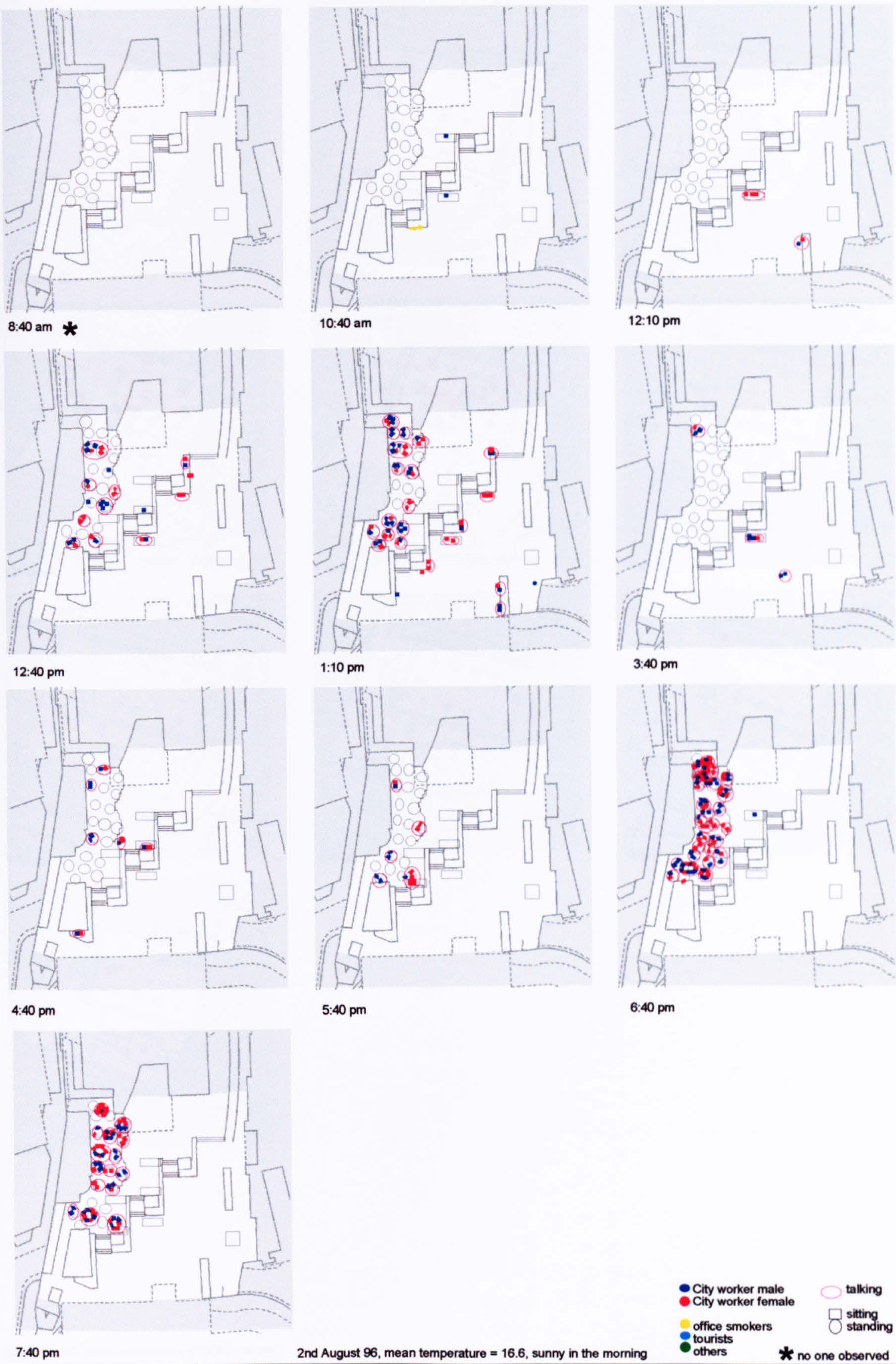
scale: 1:1200



30th July 96, mean temperature = 19.6, cloudy

Plate 6.14. Pattern of static people distribution: Fleet Place (2/2)

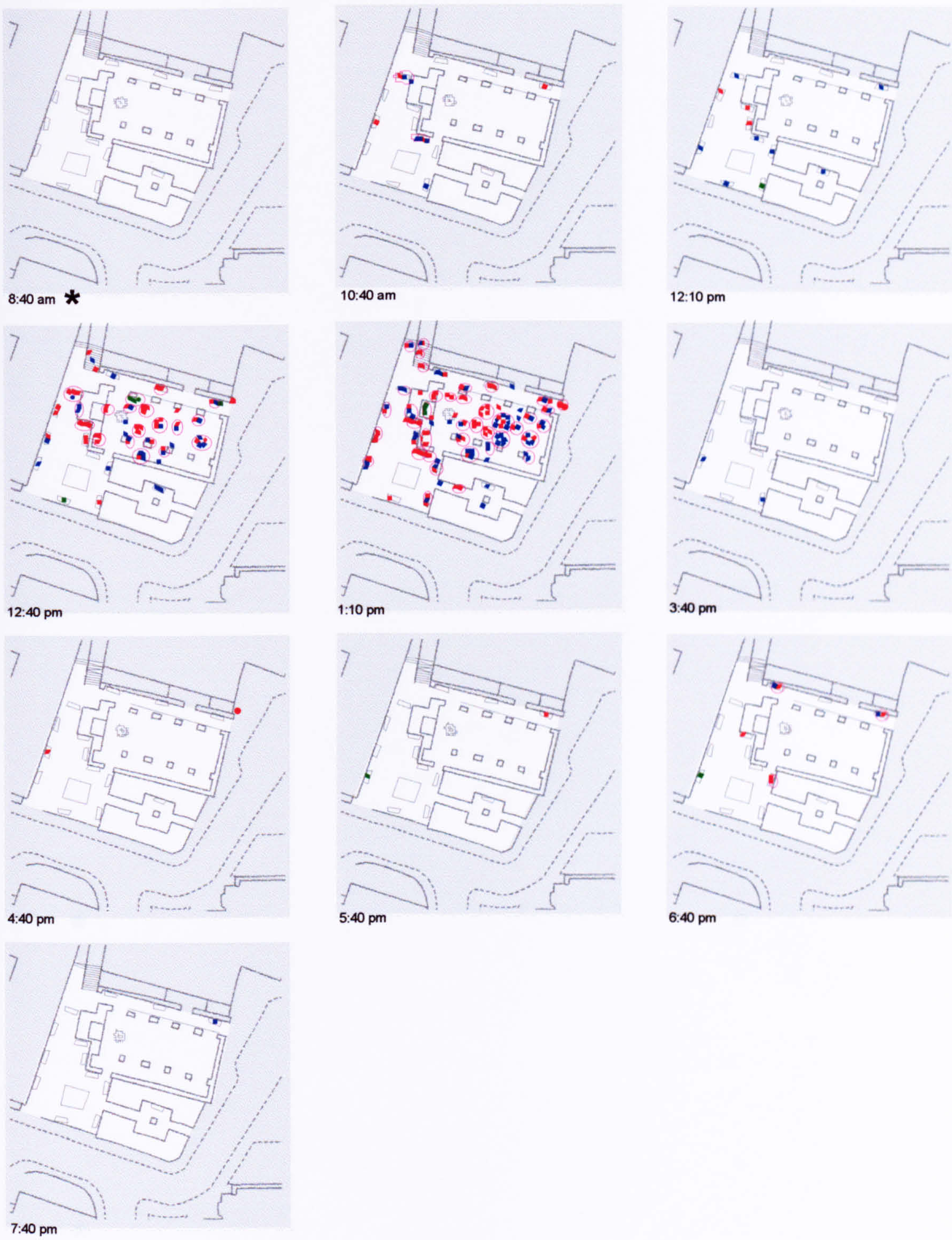
scale: 1:1200



2nd August 96, mean temperature = 16.6, sunny in the morning

Plate 6.15. Pattern of static people distribution: Love Lane Corner (1/2)

scale: 1:1200



22nd July 96, mean temperature = 24.7 C, sunny

- City worker male
- City worker female
- office smokers
- tourists
- others

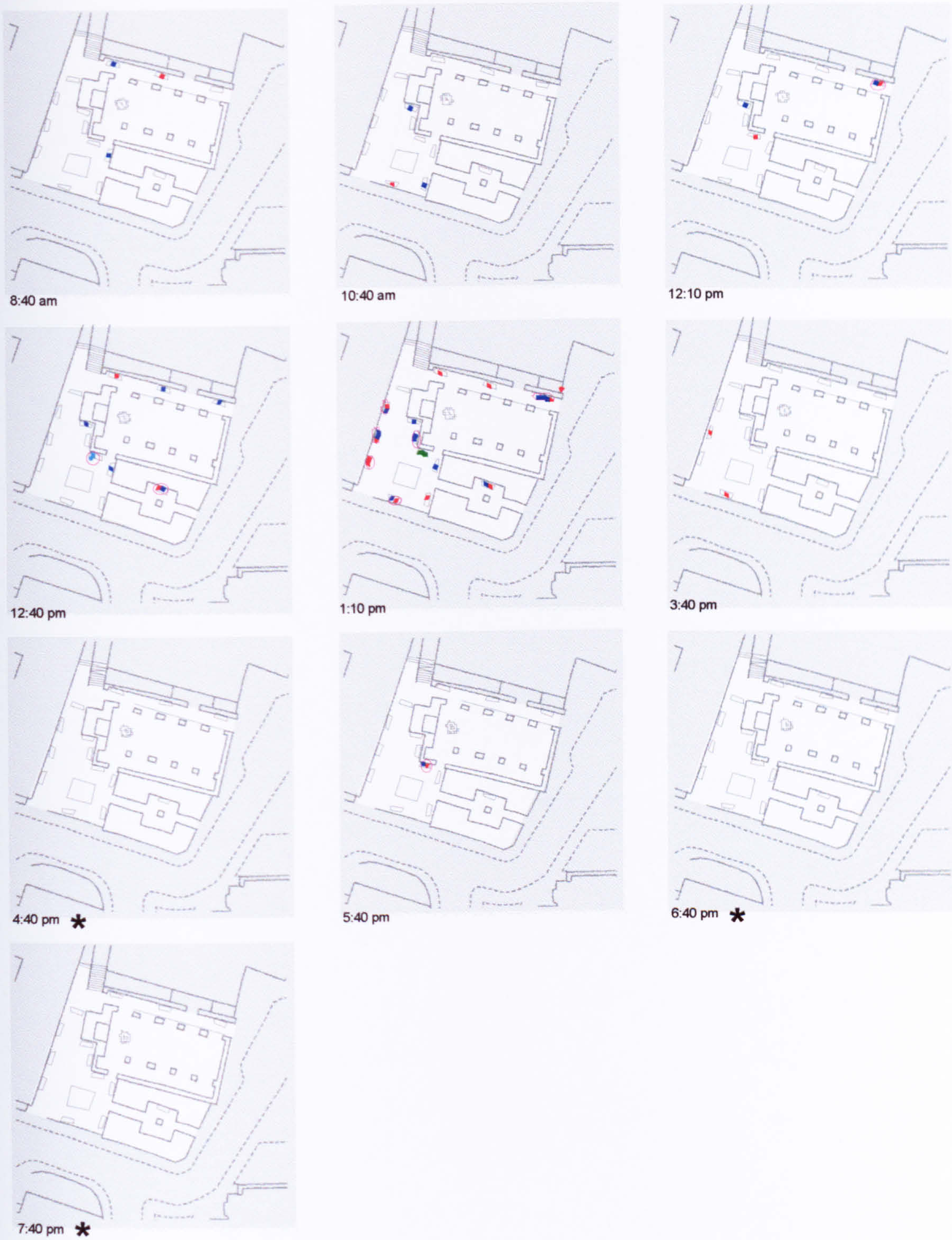
talking

sitting

standing

* no one observed

Plate 6.15. Pattern of static people distribution: *Love Lane Corner* (2/2) scale: 1:1200



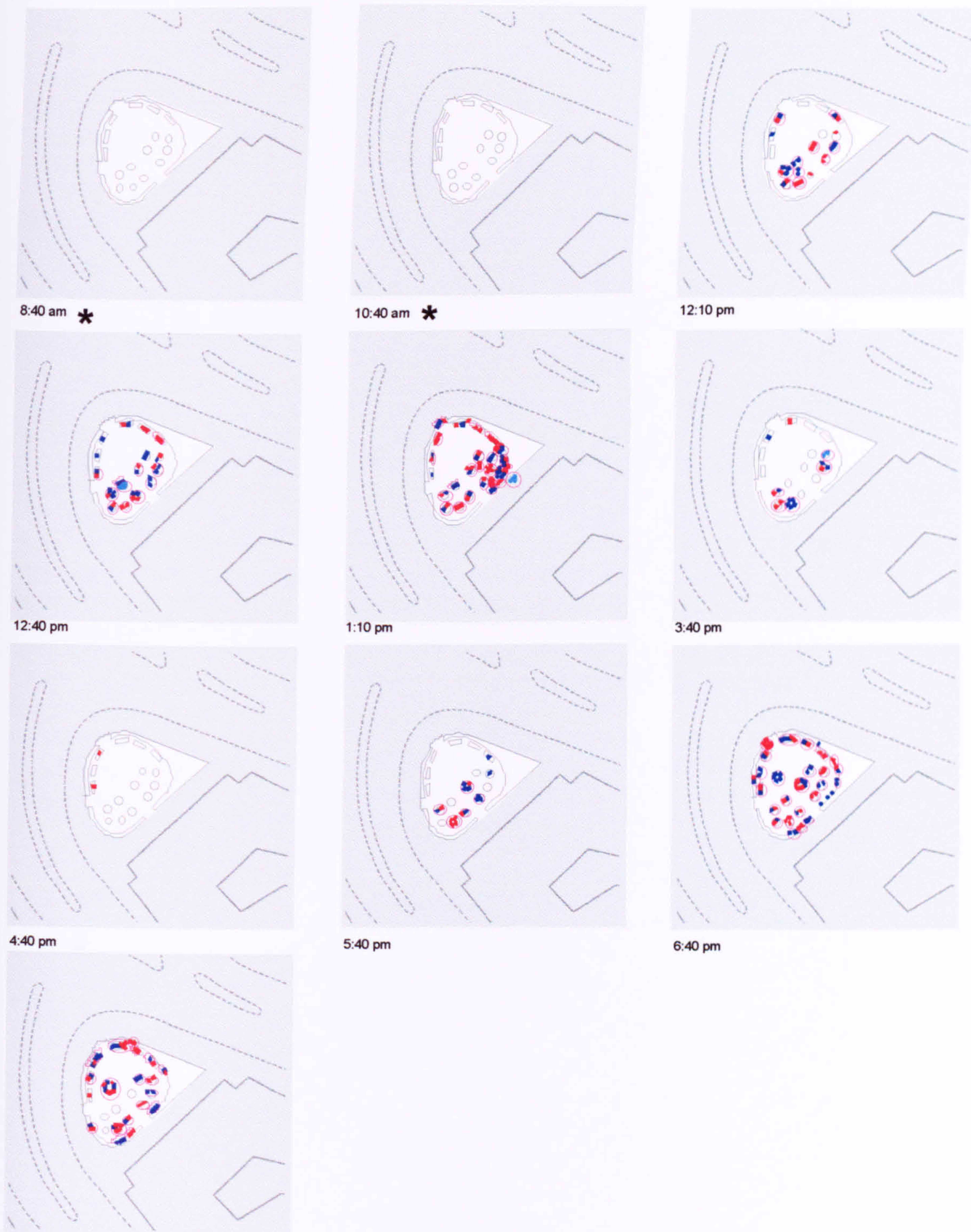
City worker male
City worker female
office smokers
tourists
others

talking
sitting
standing
* no one observed

2nd August 96, mean temperature = 16.6 C, sunny in the morning

Plate 6.16. Pattern of static people distribution: New Change/Cheapside Corner (1/2)

scale: 1:1200



22nd July 96, mean temperature = 24.7 C, sunny

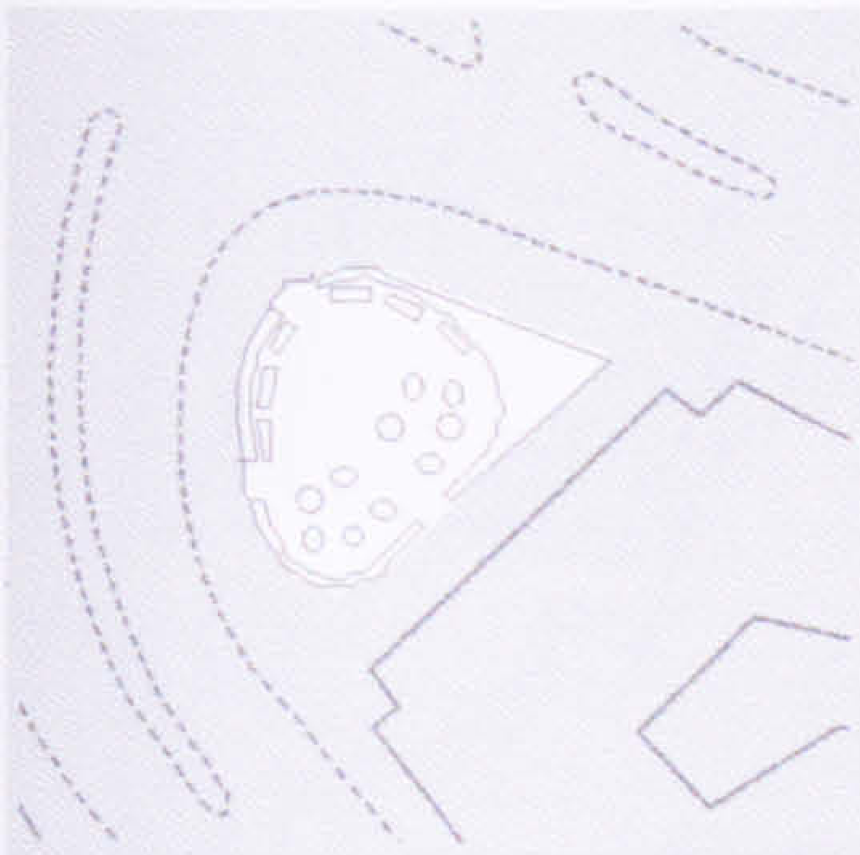
City worker male
City worker female
office smokers
tourists
others

talking
sitting
standing

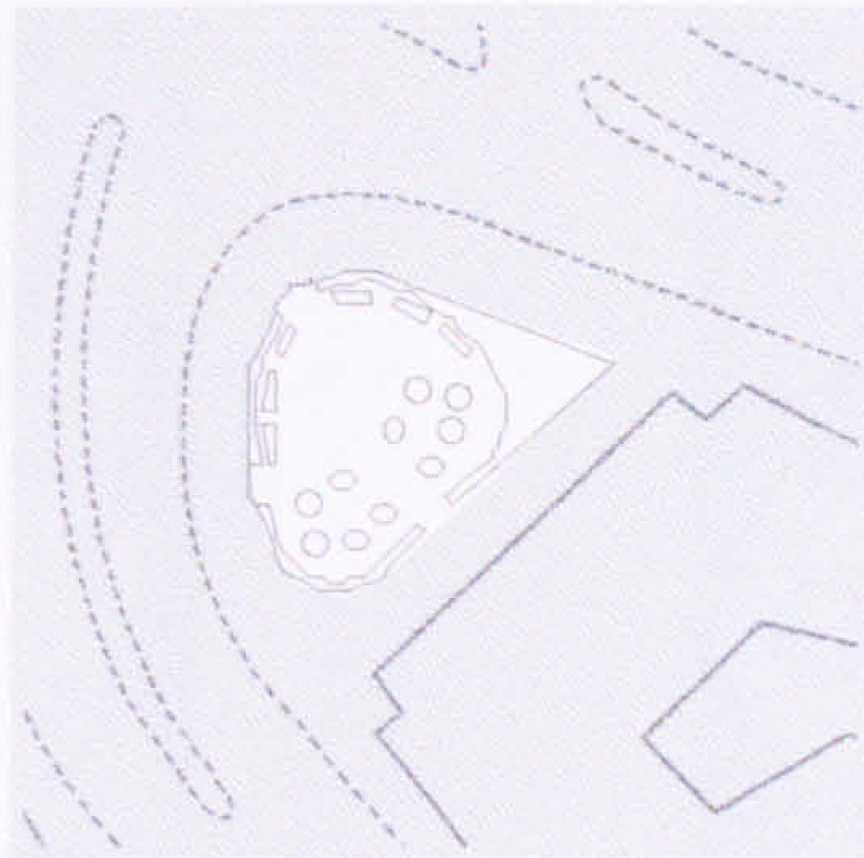
* no one observed

Plate 6.16. Pattern of static people distribution: New Change/Cheapside Corner (2/2)

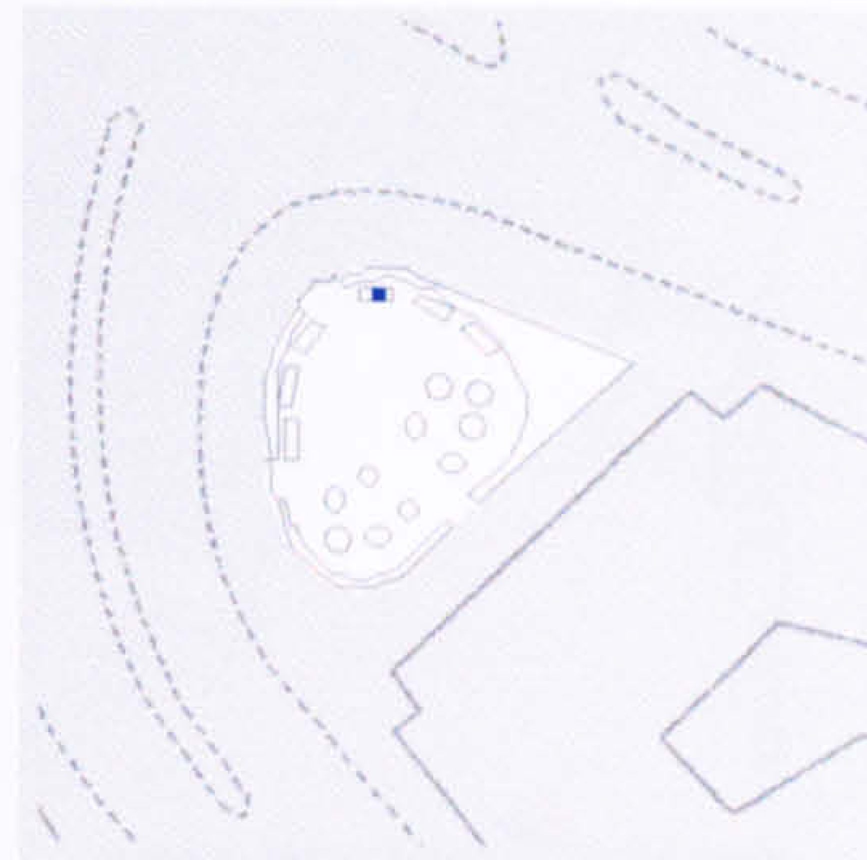
scale: 1:1200



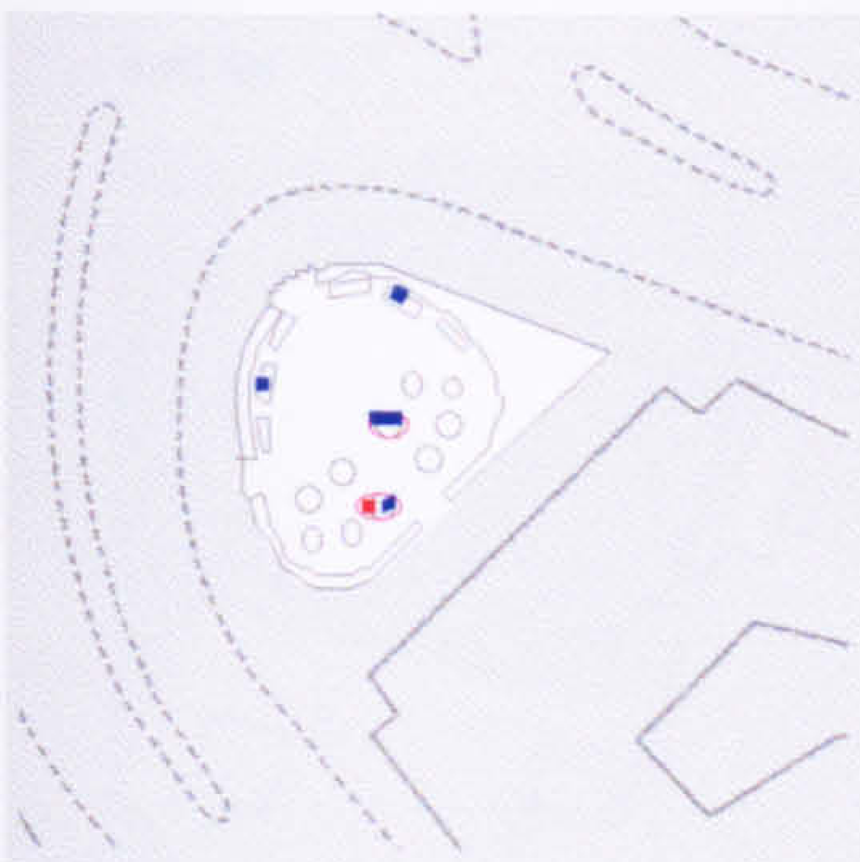
8:40 am *



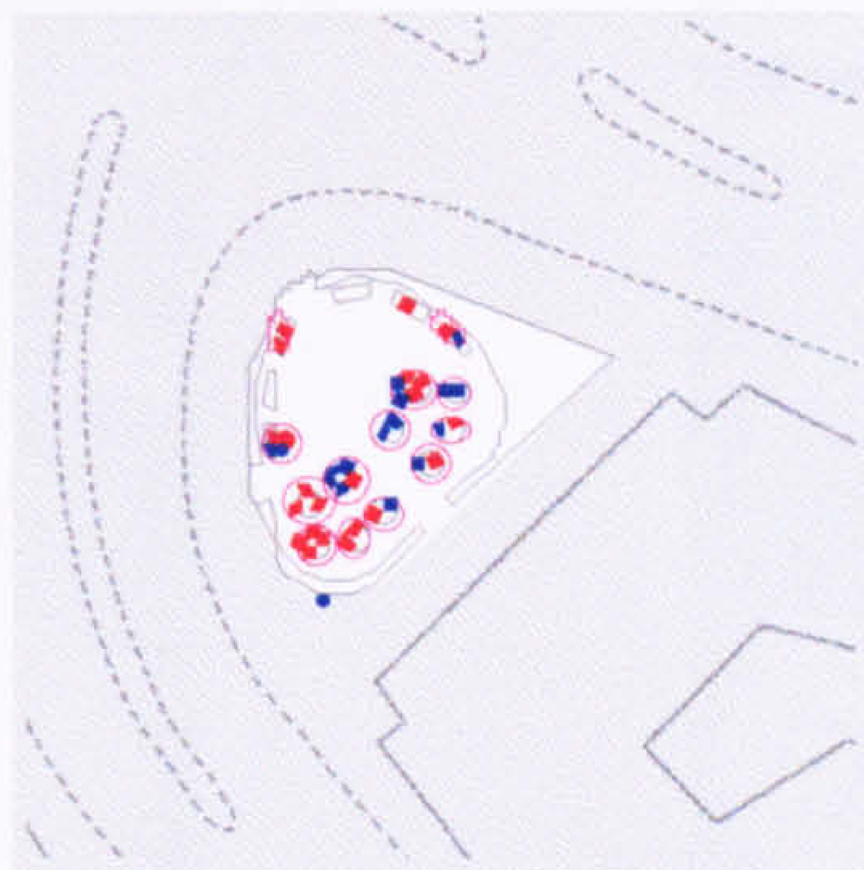
10:40 am *



12:10 pm

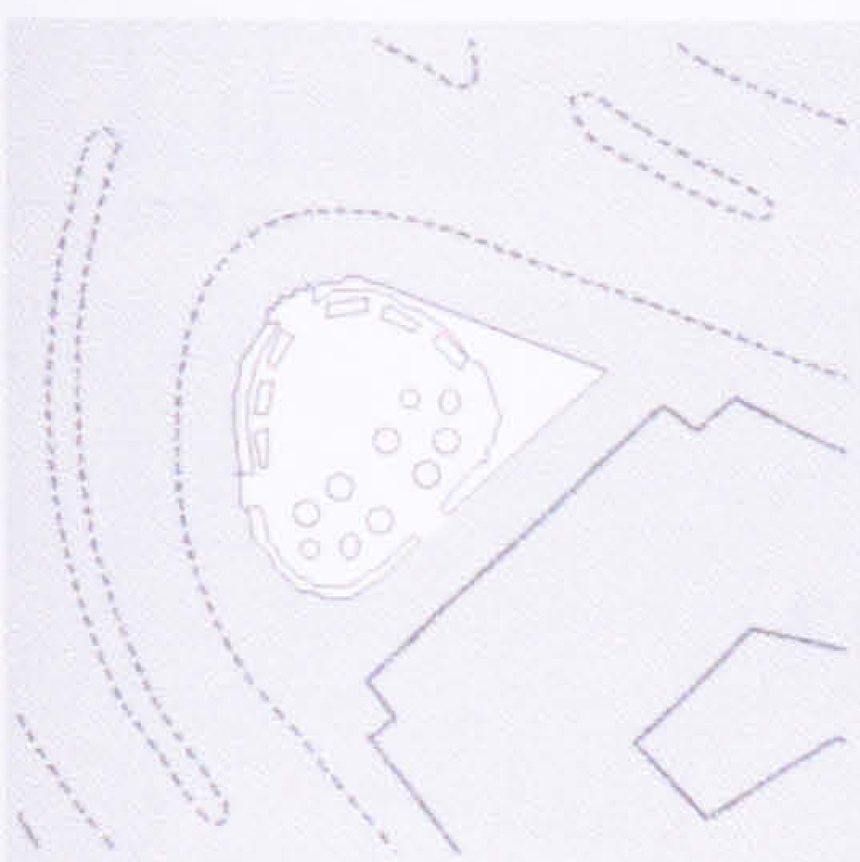


12:40 pm

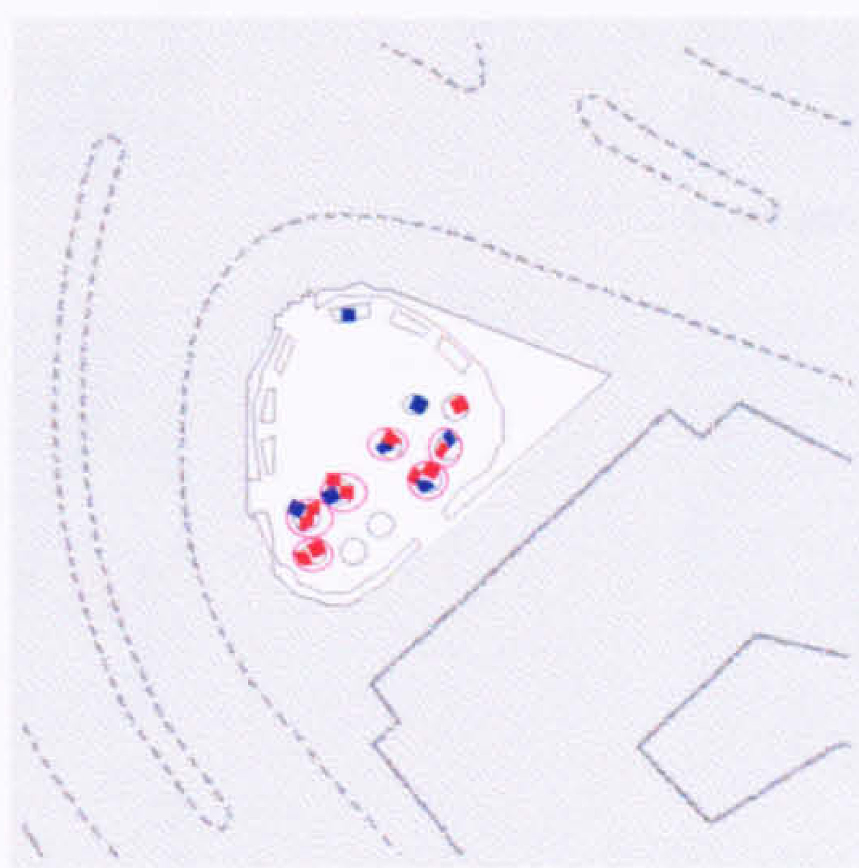


1:10 pm

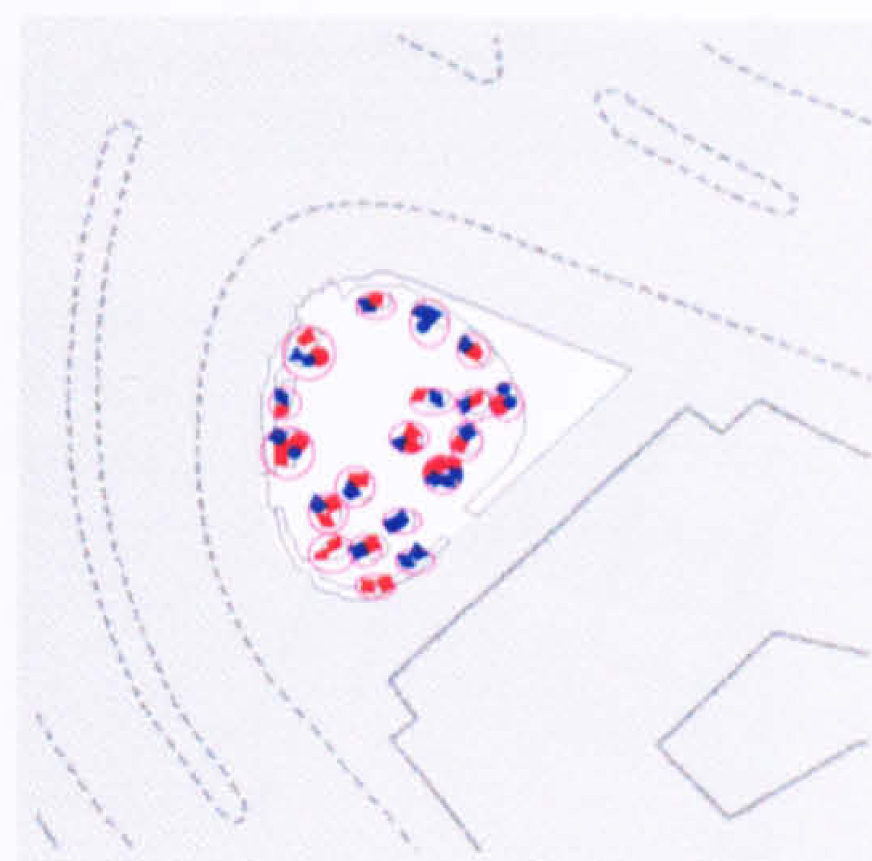
3:40 pm



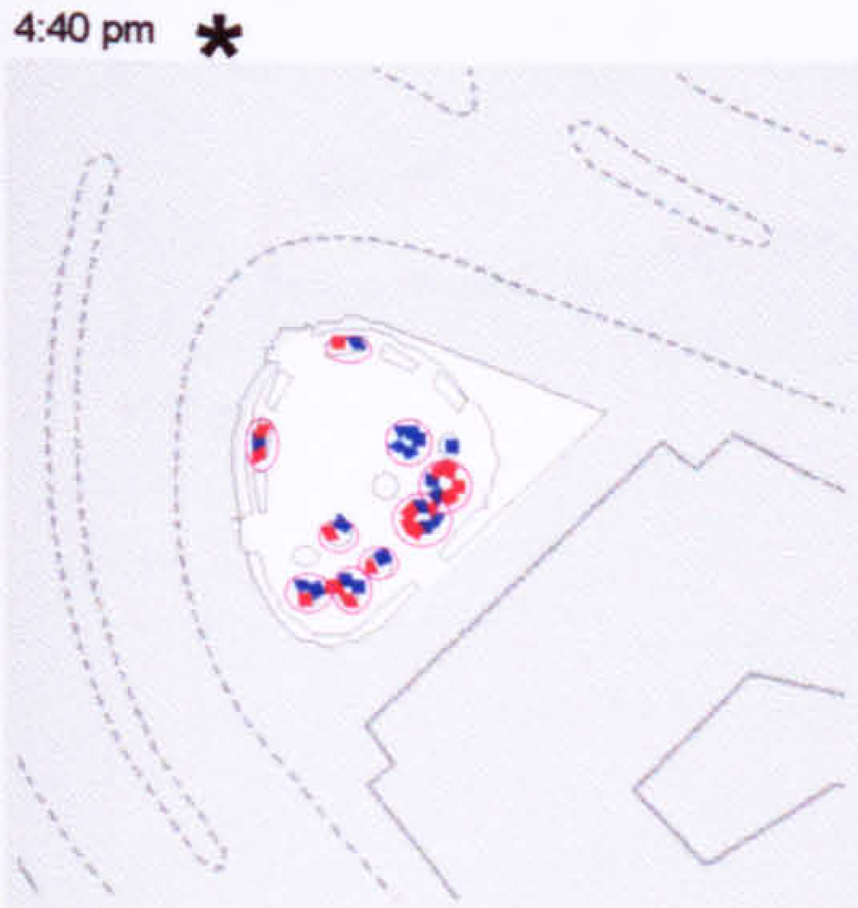
4:40 pm *



5:40 pm



6:40 pm



7:40 pm

City worker male
City worker female

office smokers
tourists
others

talking

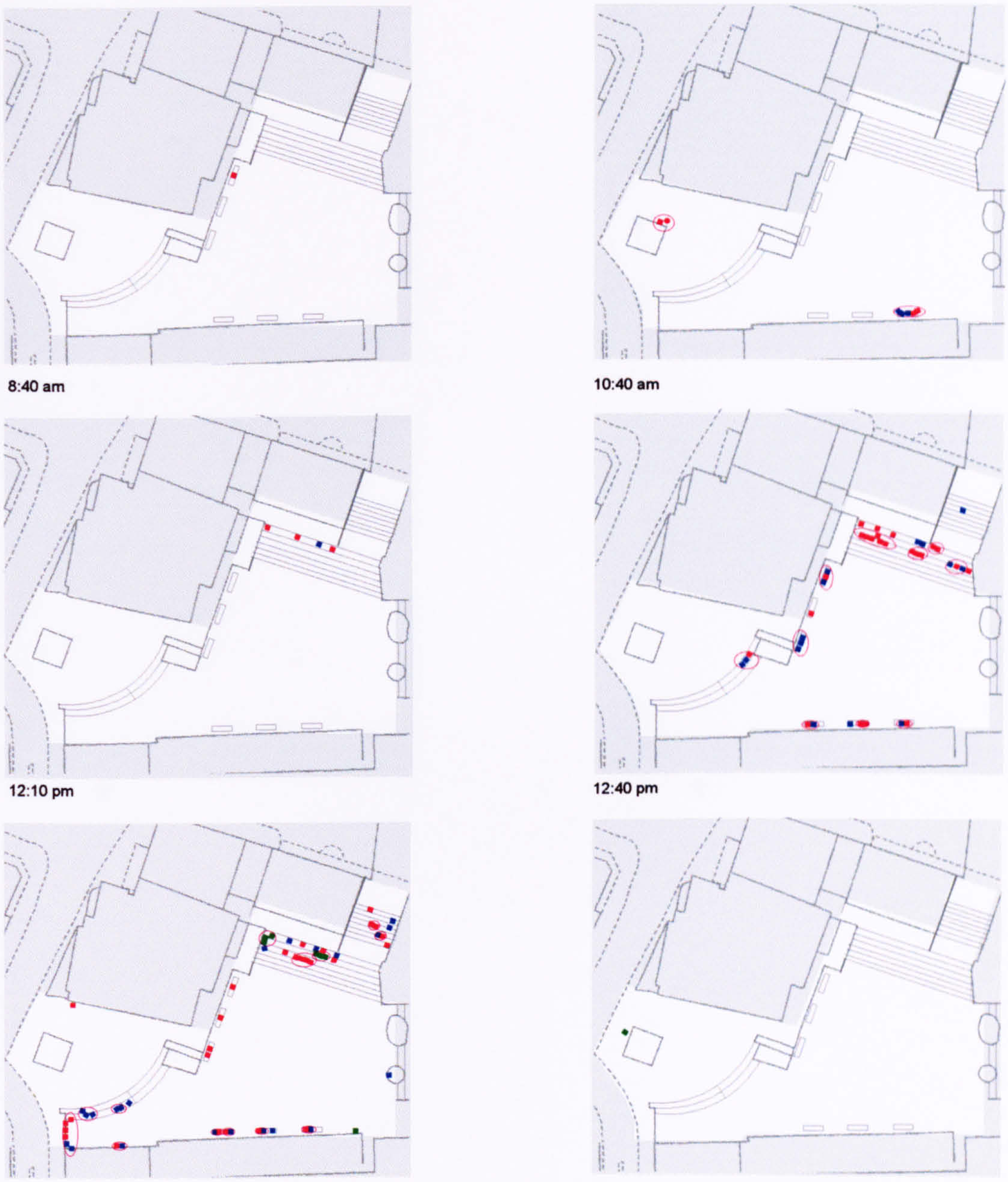
sitting
standing

* no one observed

3rd August 96, mean temperature = 18.1 C, sunny

Plate 6.17. Pattern of static people distribution: North Guildhall (1/4)

scale: 1:1200

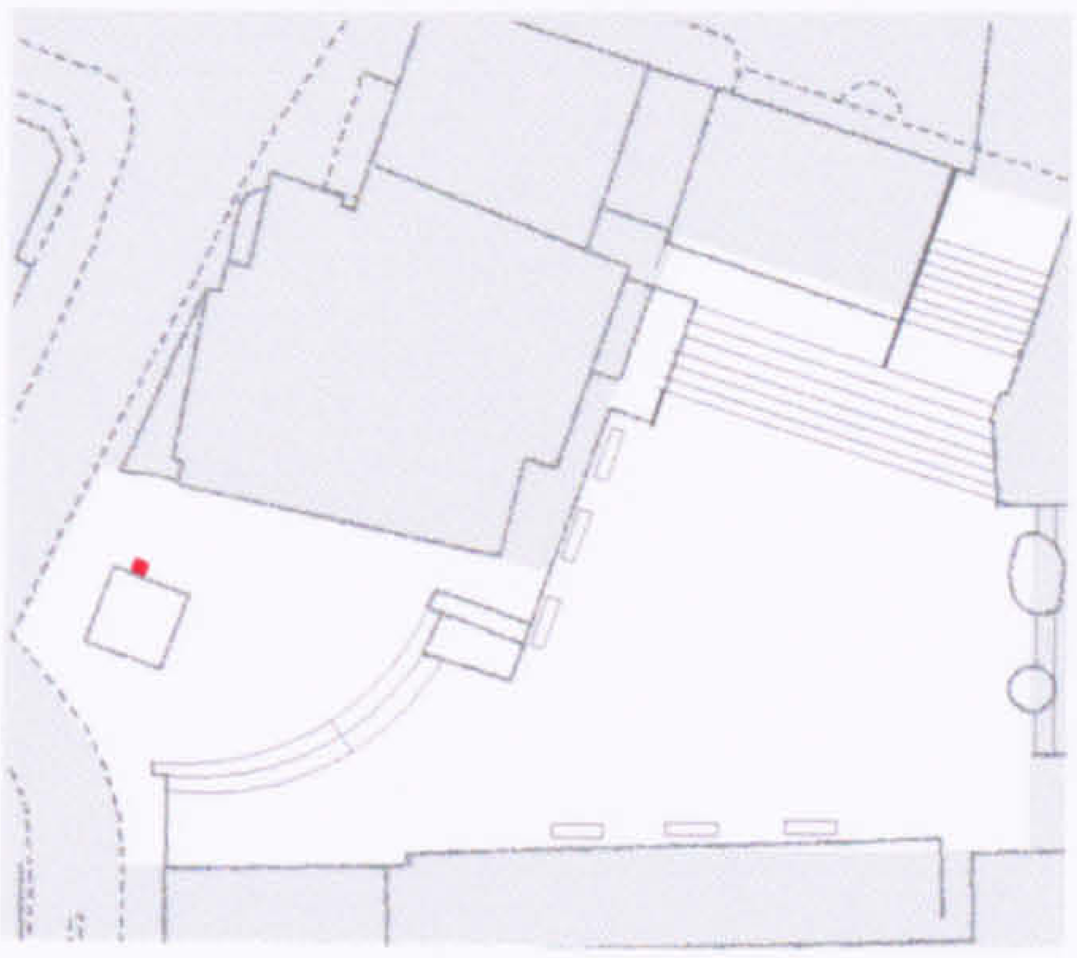


- City worker male
- City worker female
- office smokers
- tourists
- others

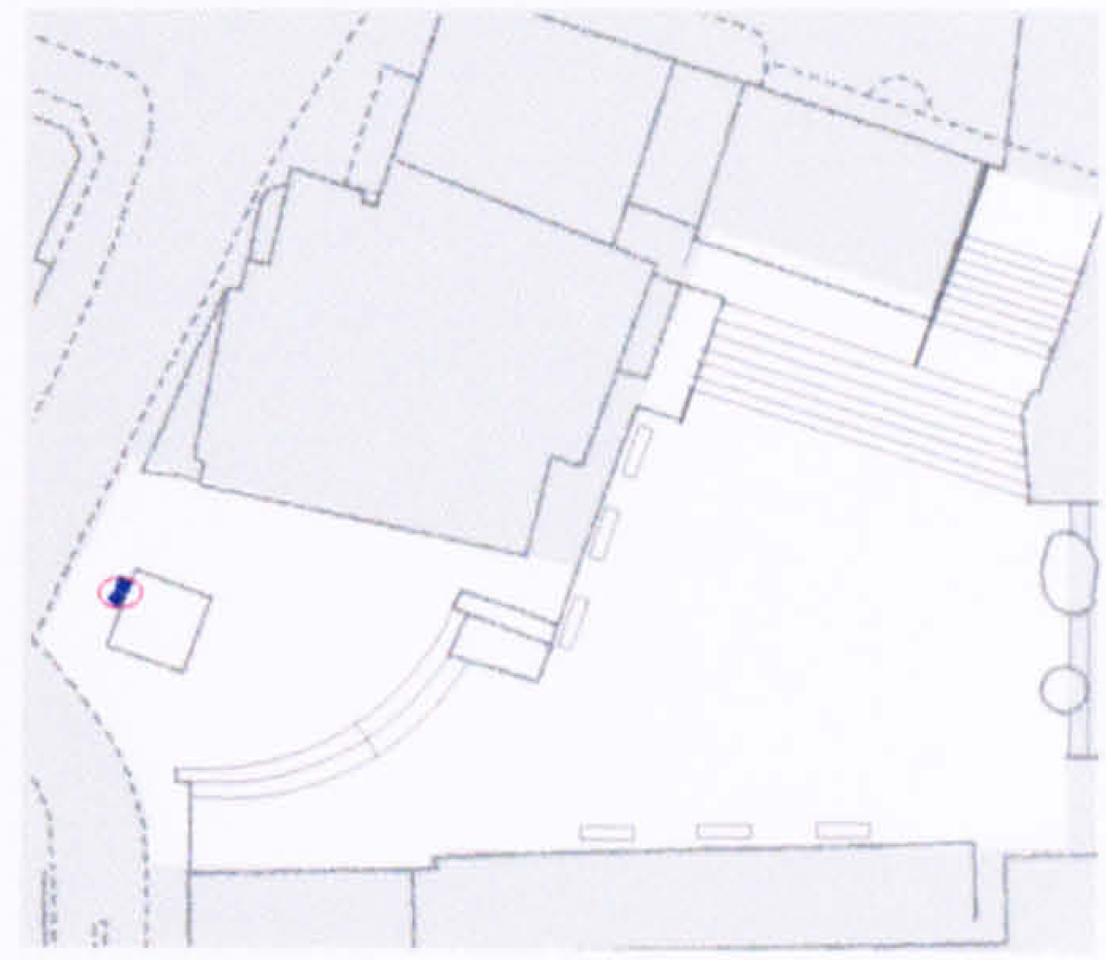
talking
sitting
standing

* no one observed

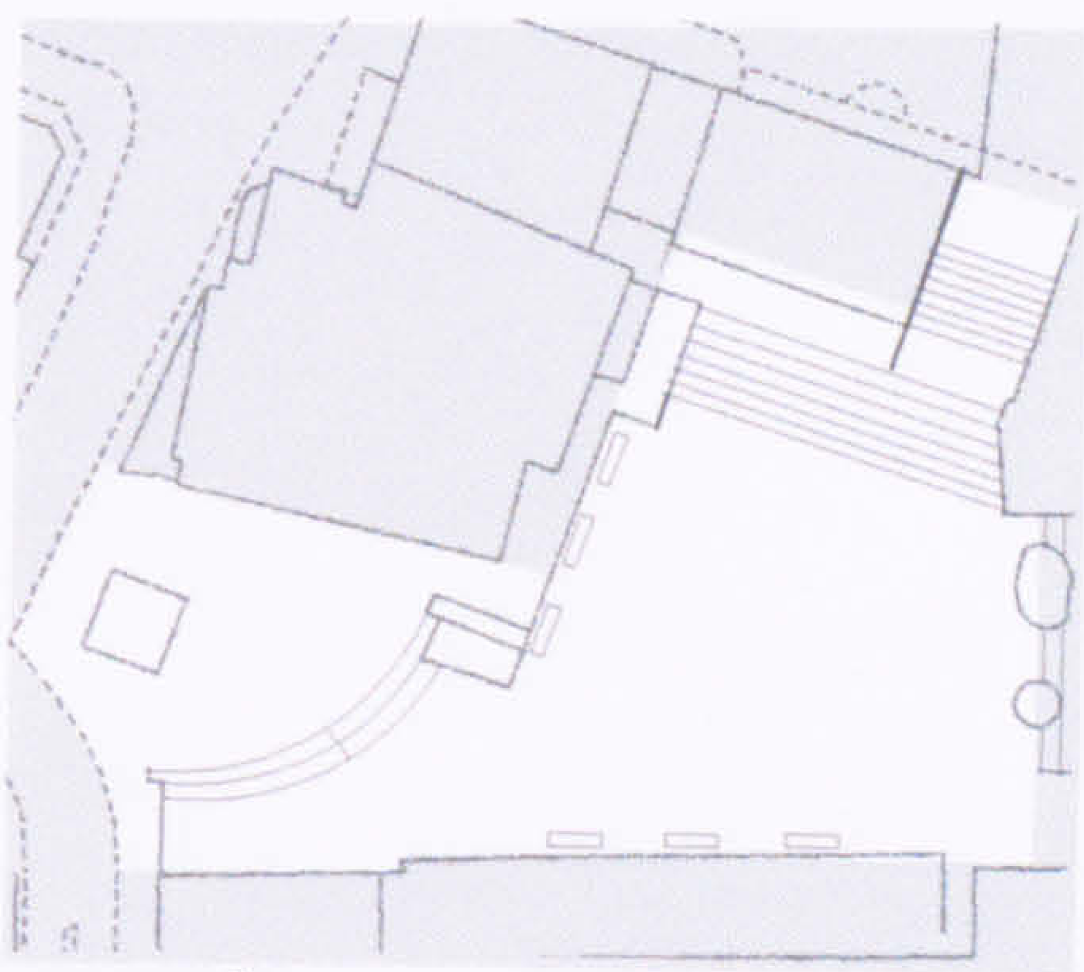
22nd July 96, mean temperature = 24.7 C, sunny



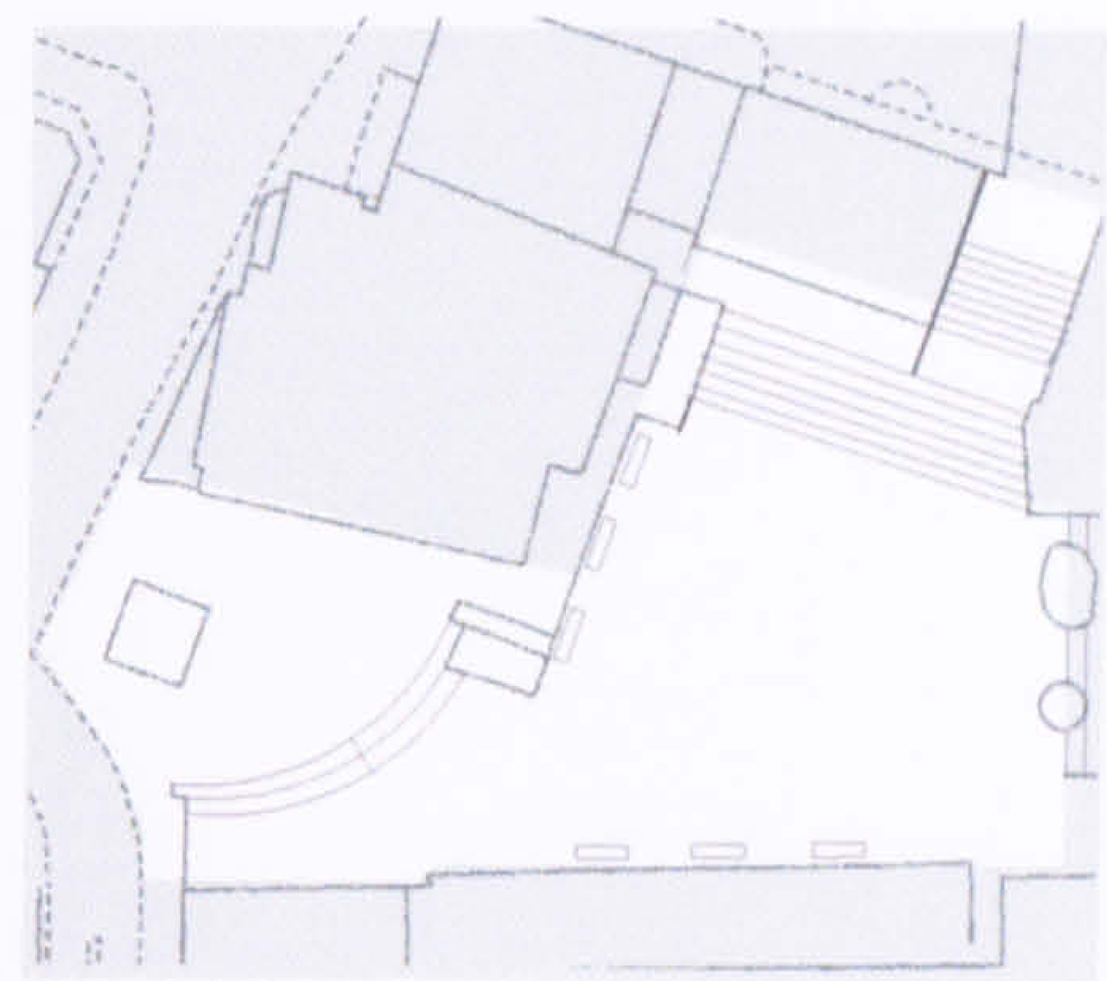
4:40 pm



5:40 pm



6:40 pm *



7:40 pm *

- City worker male
- City worker female
- office smokers
- tourists
- others

talking

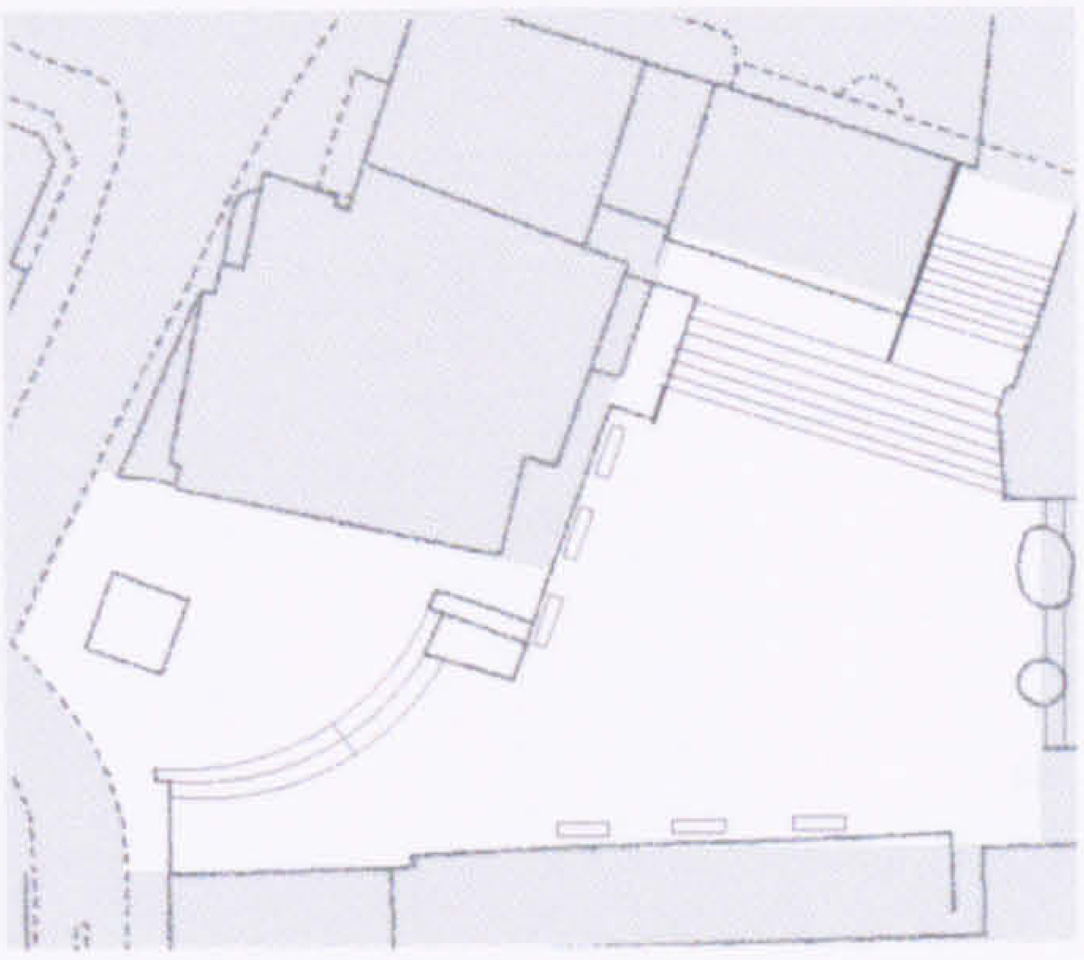
sitting
standing

* no one observed

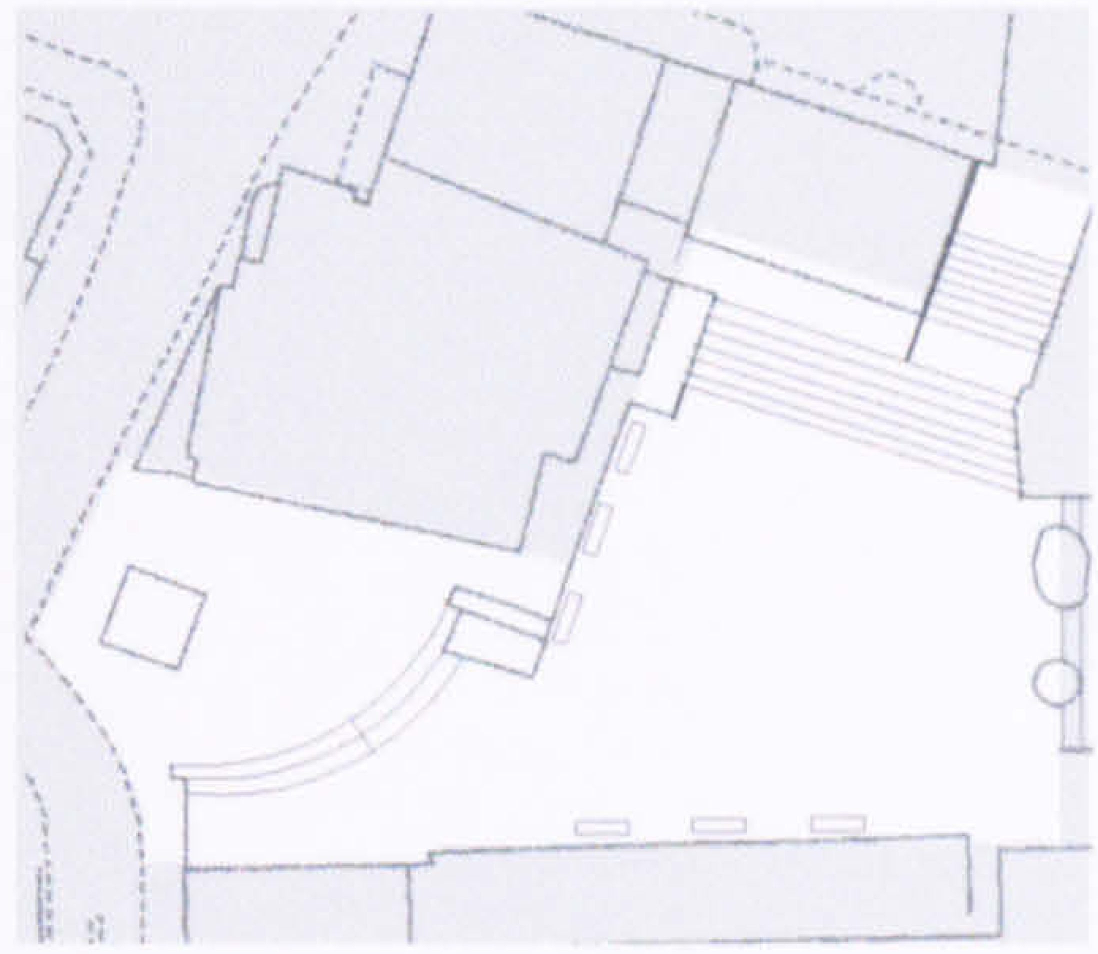
22nd July 96, mean temperature = 24.7 C, sunny

Plate 6.17. Pattern of static people distribution: North Guildhall (3/4)

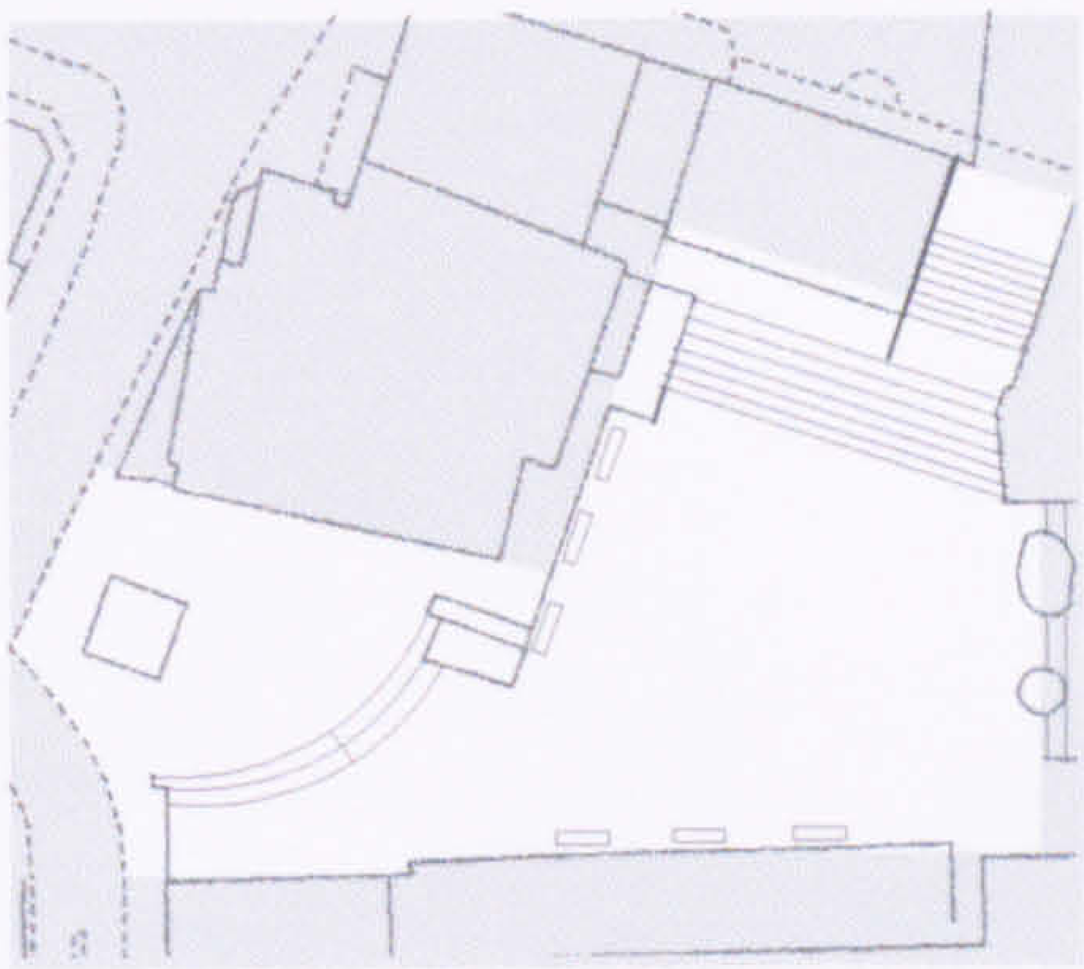
scale: 1:1200



8:40 am *



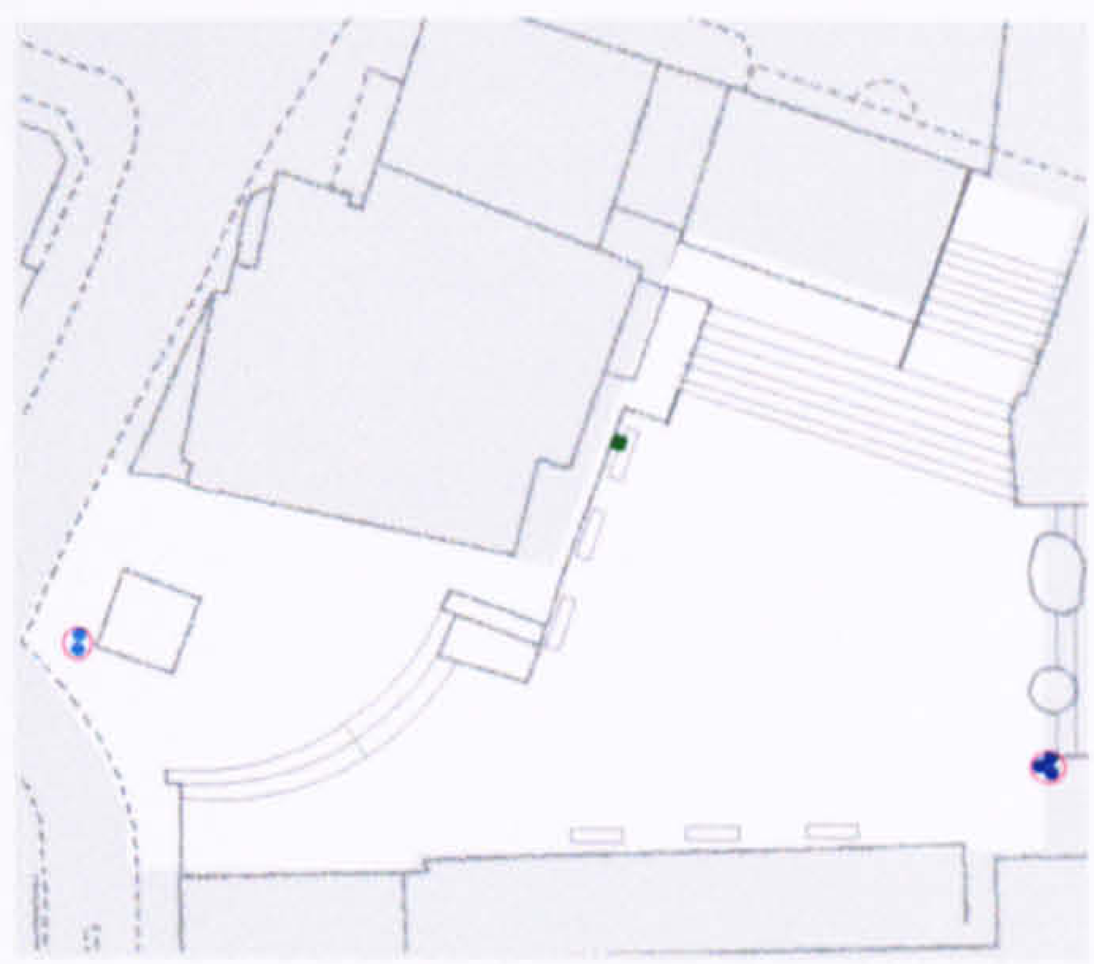
10:40 am *



12:10 pm *

12:40 pm

1:10 pm



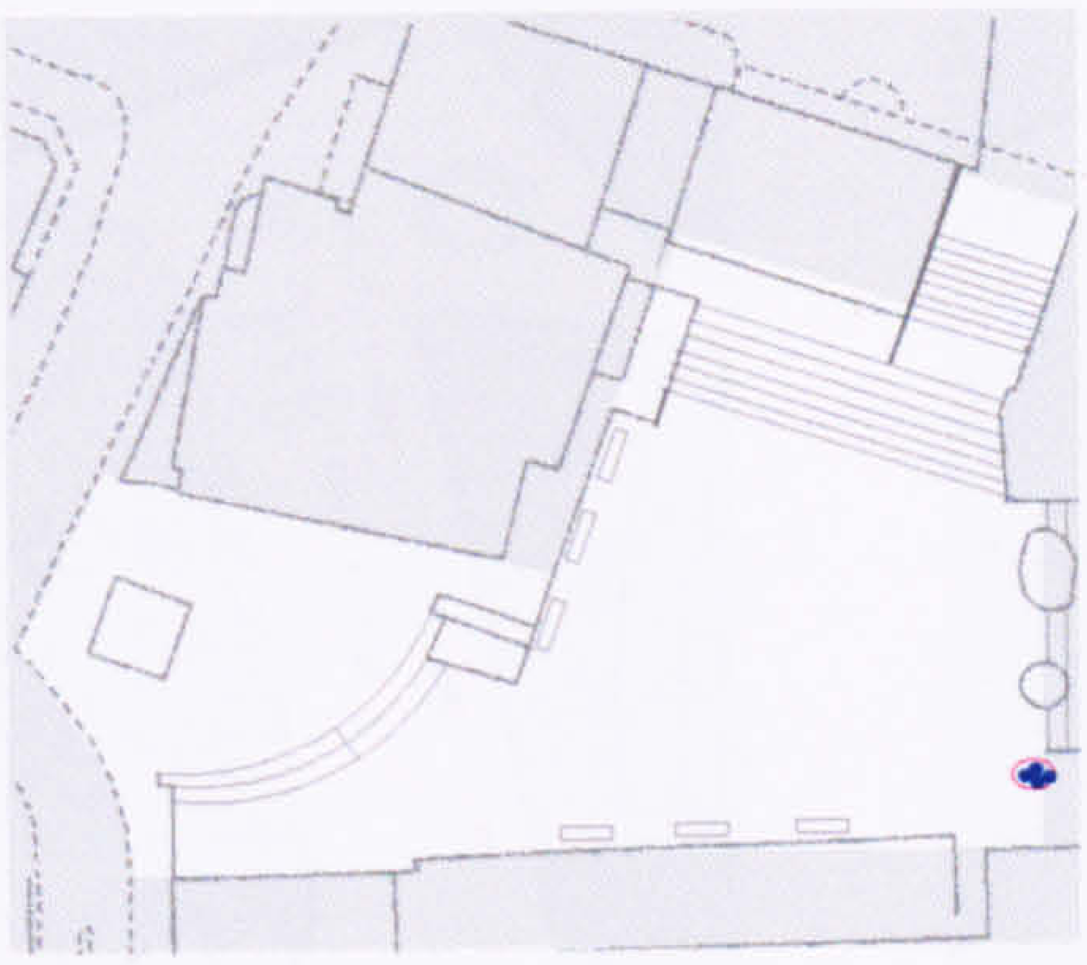
3:40 pm

● City worker male
● City worker female
● office smokers
● tourists
● others

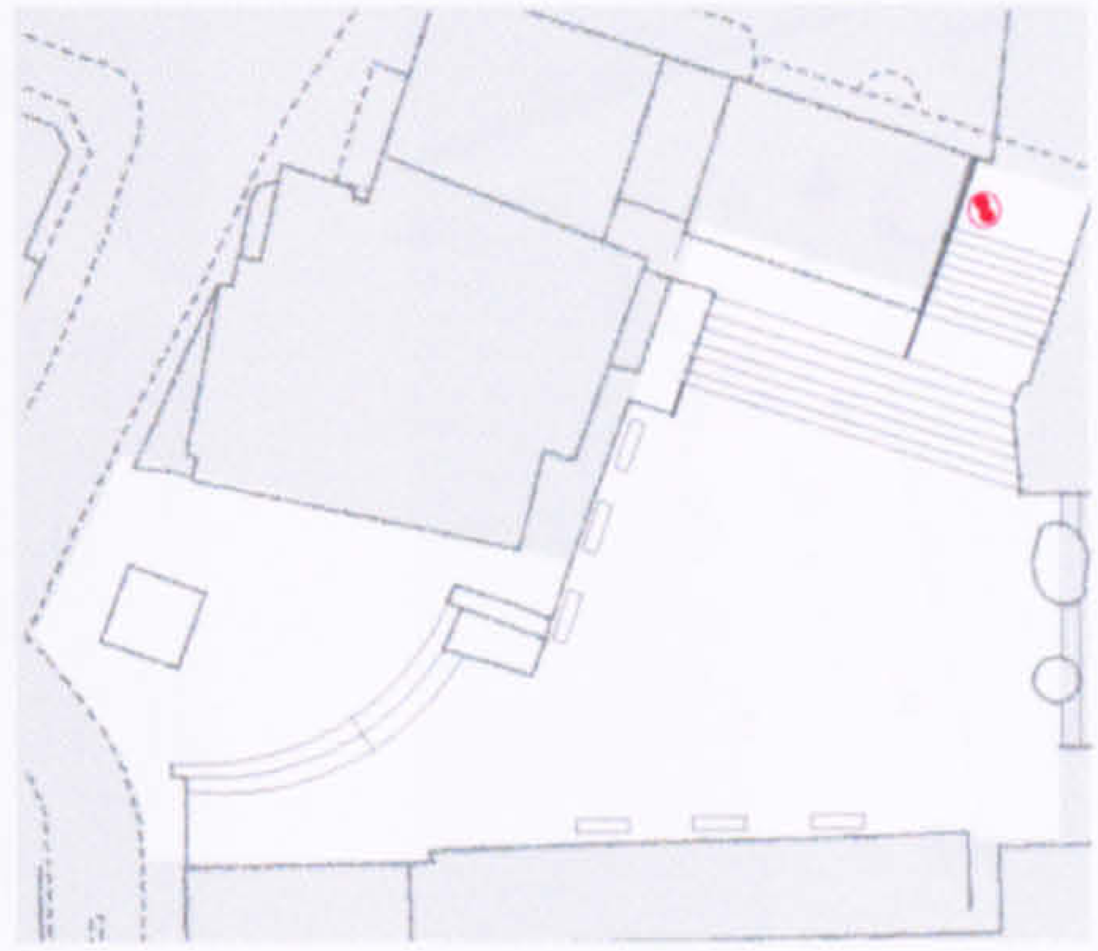
talking
sitting
standing
* no one observed

2nd August 96, mean temperature = 16.6 C, sunny in the morning

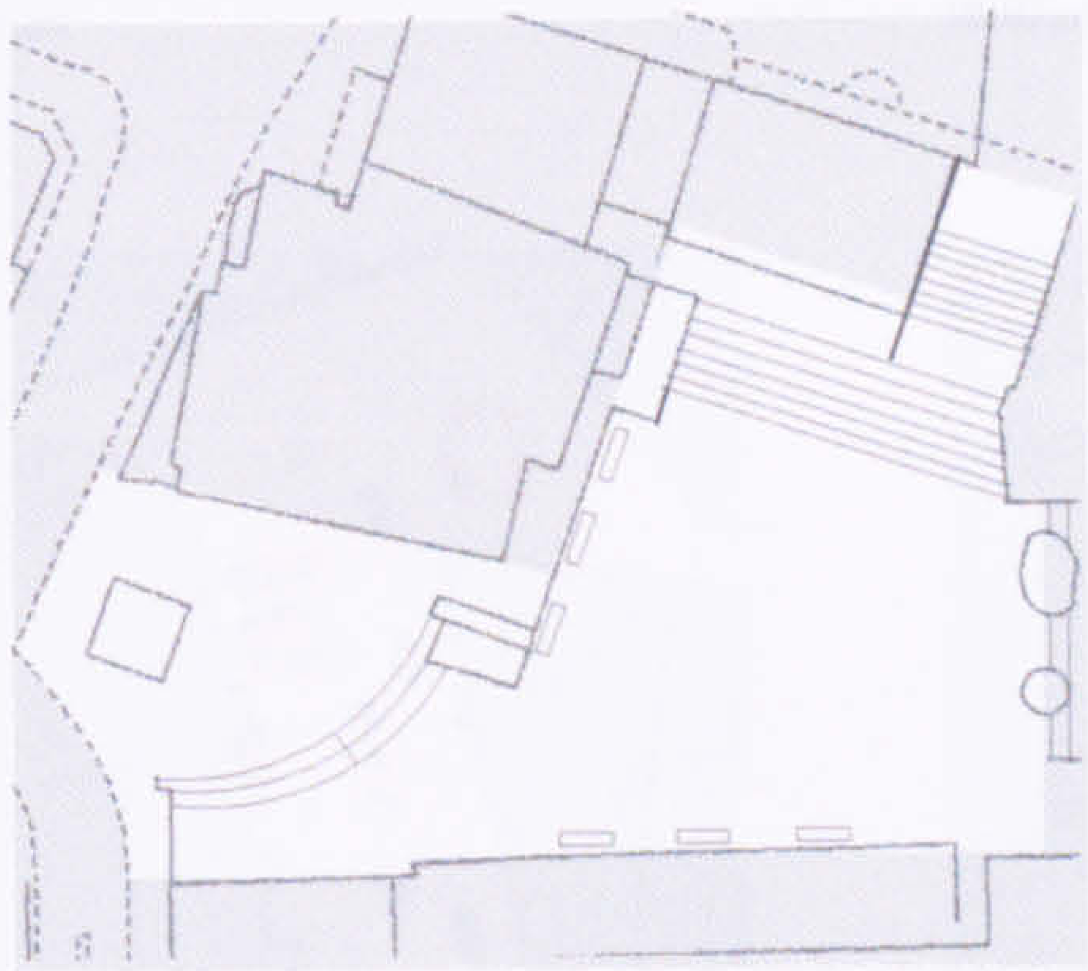
Plate 6.17. Pattern of static people distribution: North Guildhall (4/4) scale: 1:1200



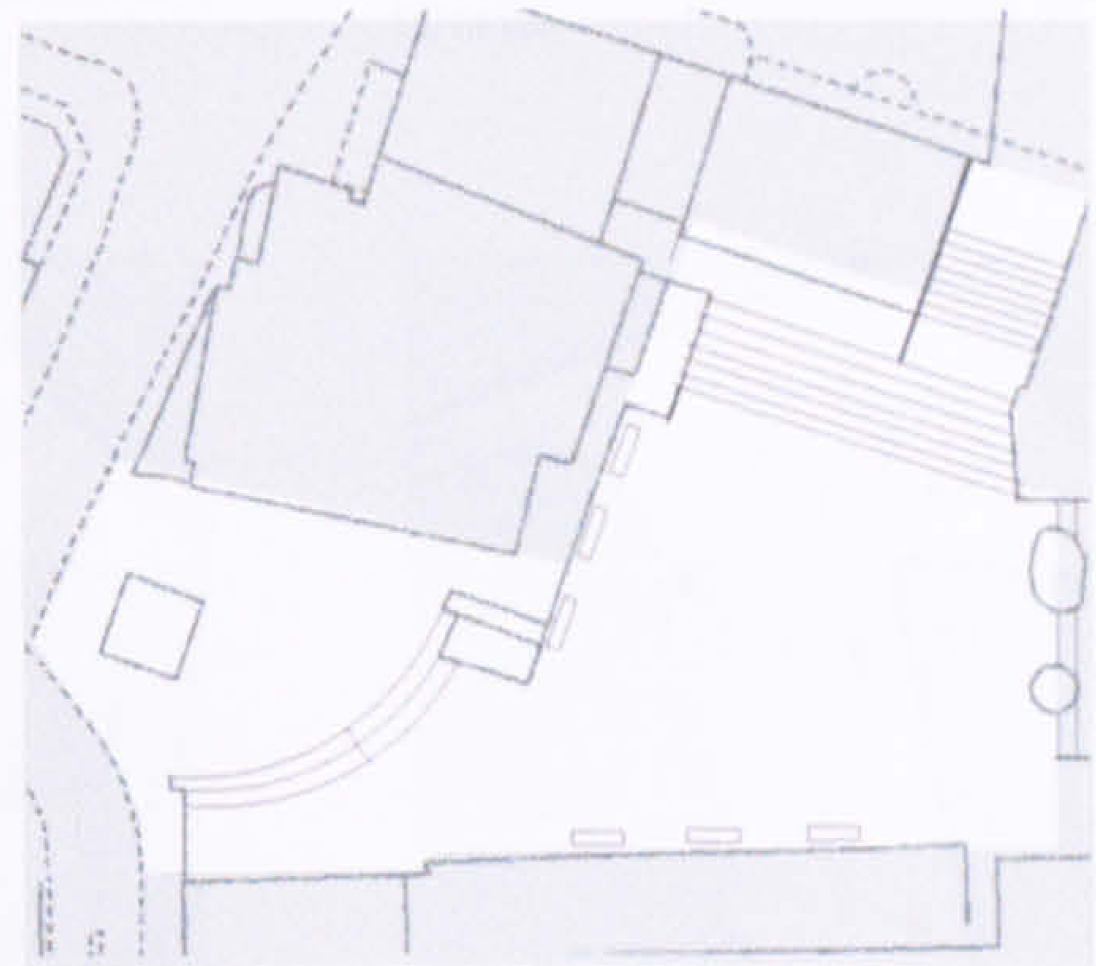
4:40 pm



5:40 pm



6:40 pm *



7:40 pm *

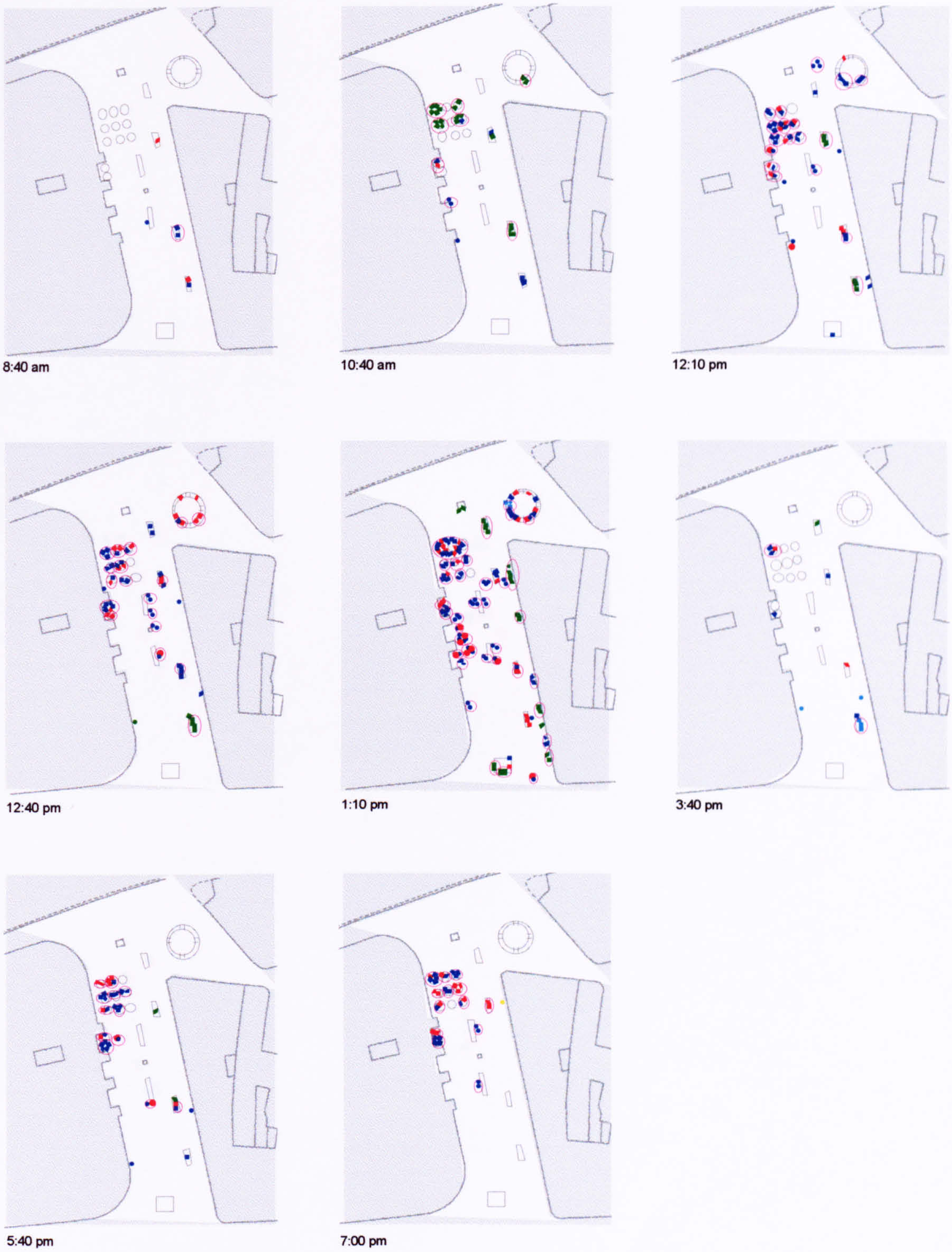
2nd August 96, mean temperature = 16.6 C, sunny in the morning

- City worker male
- City worker female
- office smokers
- tourists
- others

talking
sitting
standing
* no one observed

Plate 6.18. Pattern of static people distribution: Royal Exchange (1/2)

scale: 1:1200

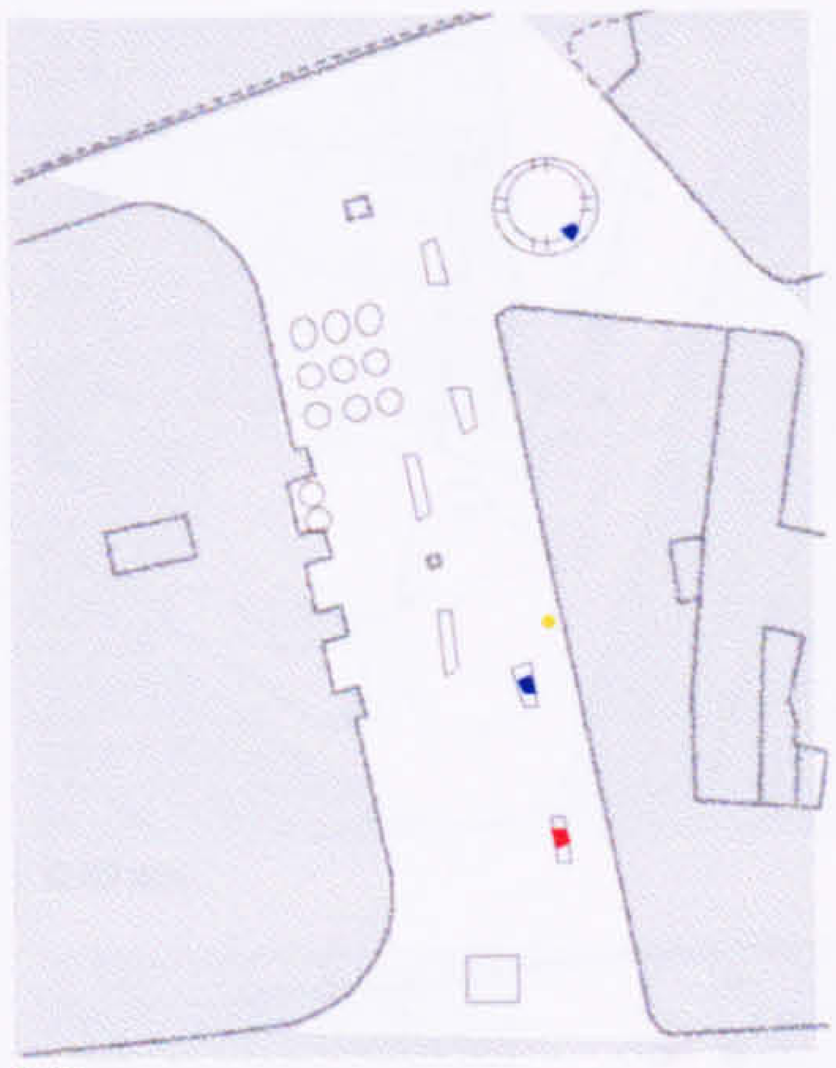


17th July 96, mean temperature = 16.8 C, sunny

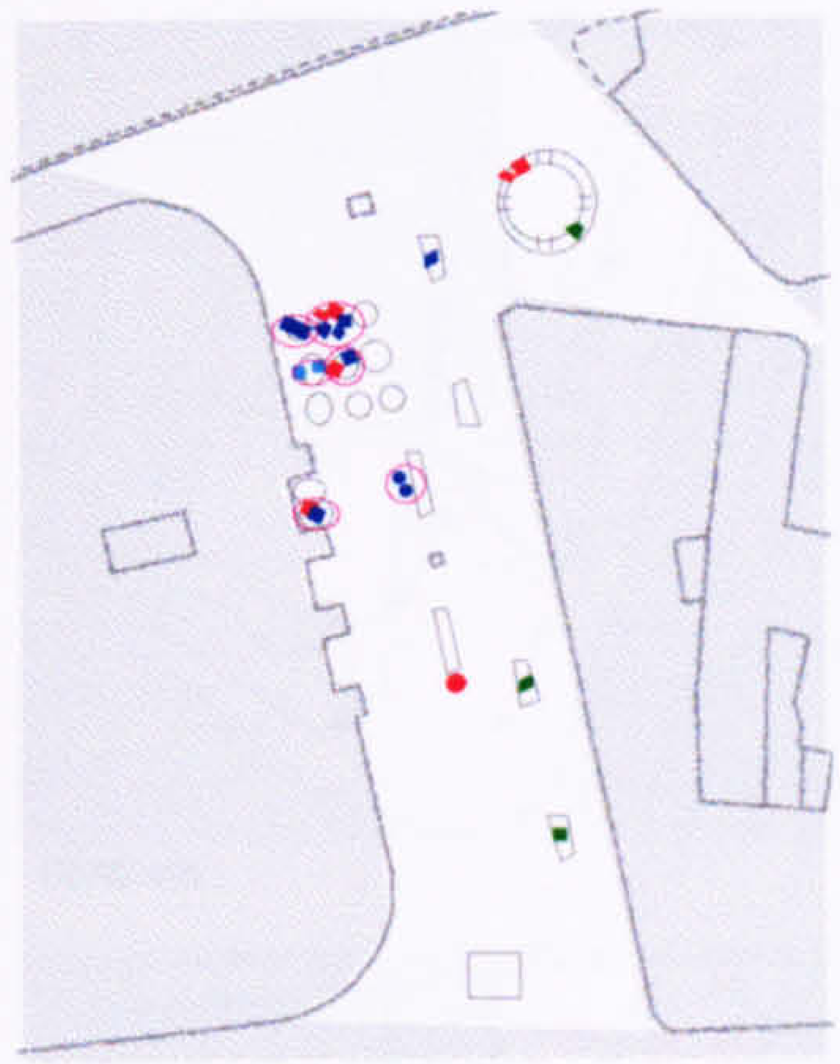
● City worker male
● City worker female
● office smokers
● tourists
● others

talking
sitting
standing
* no one observed

Plate 6.18. Pattern of static people distribution: Royal Exchange (2/2) scale: 1:1200

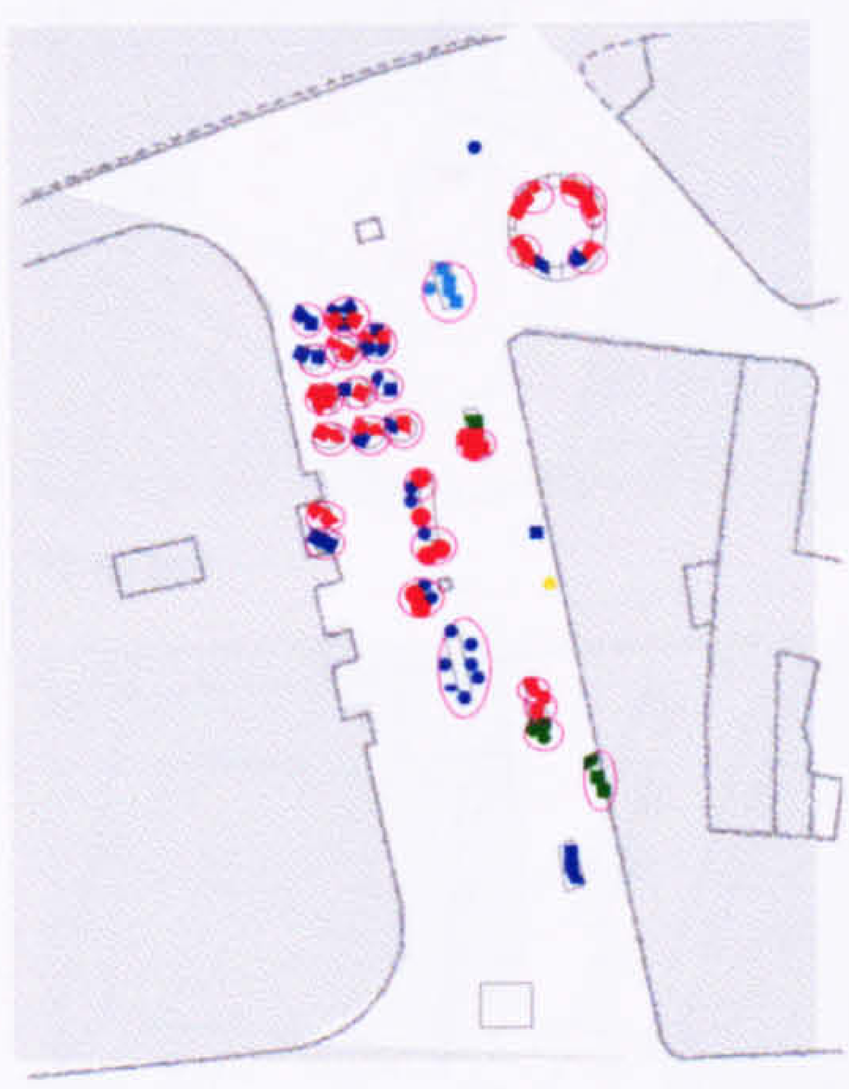


8:40 am

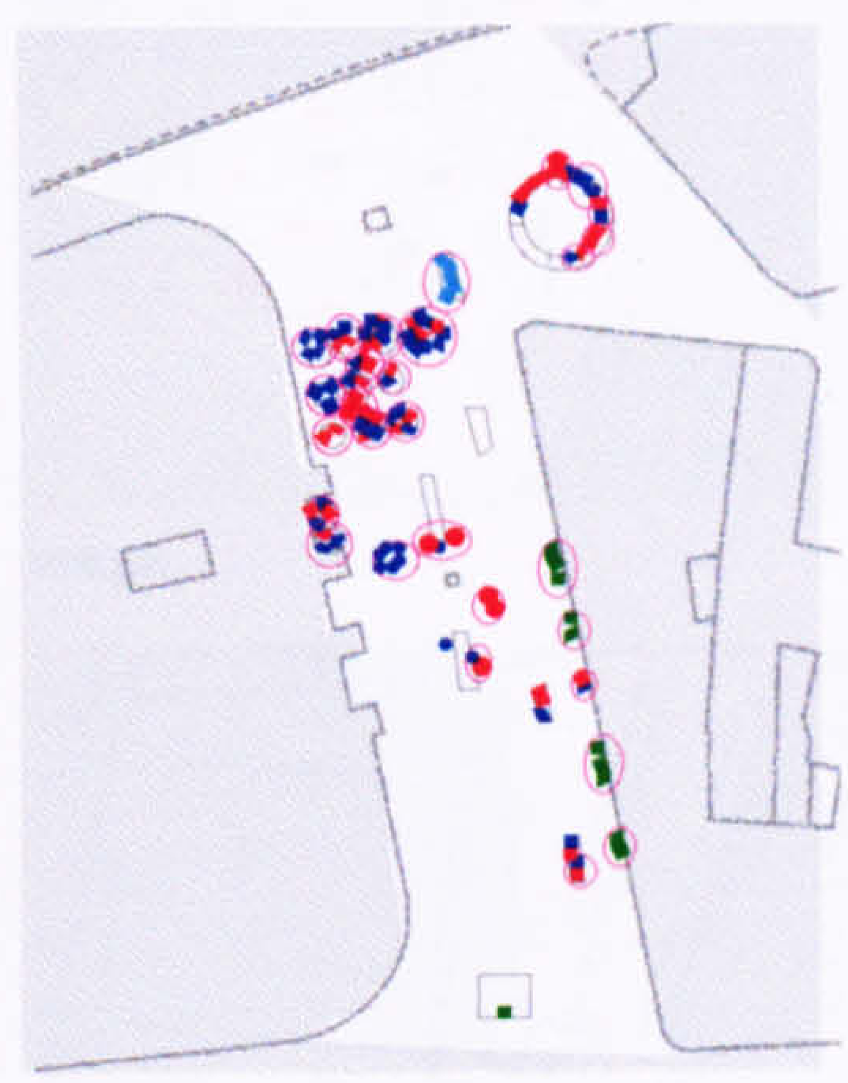


10:40 am

12:10 pm

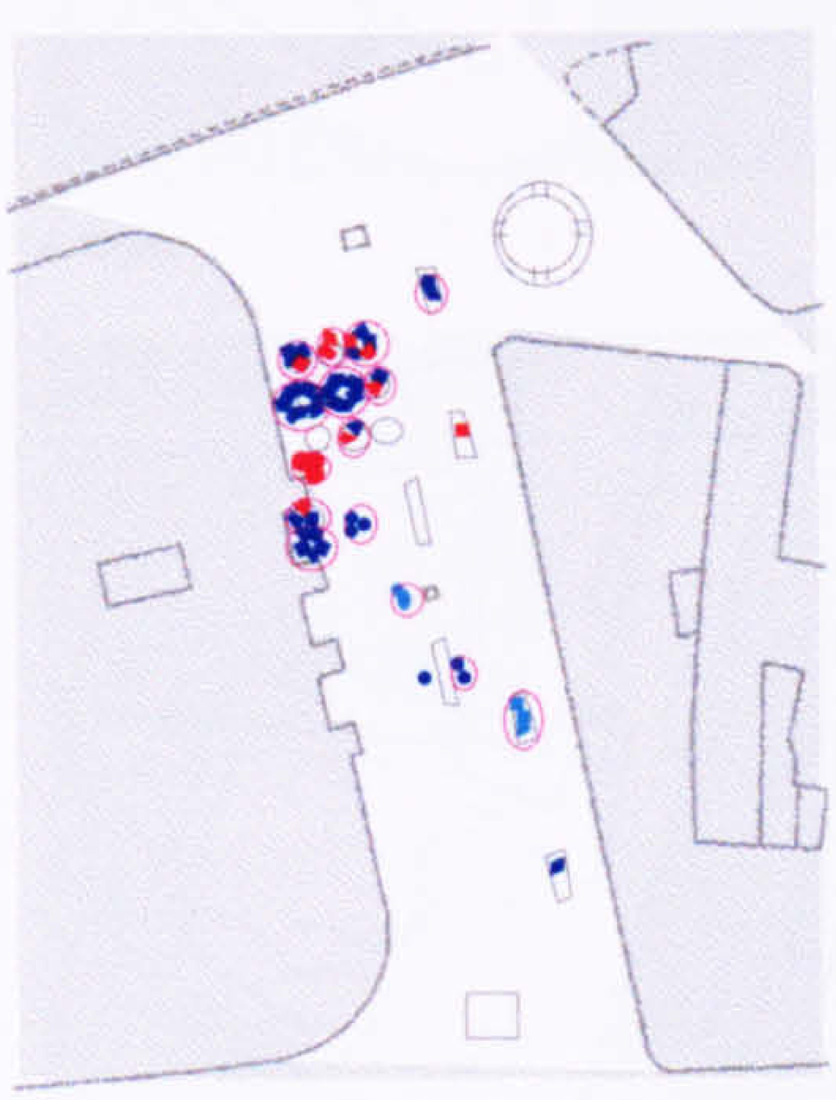


12:40 pm

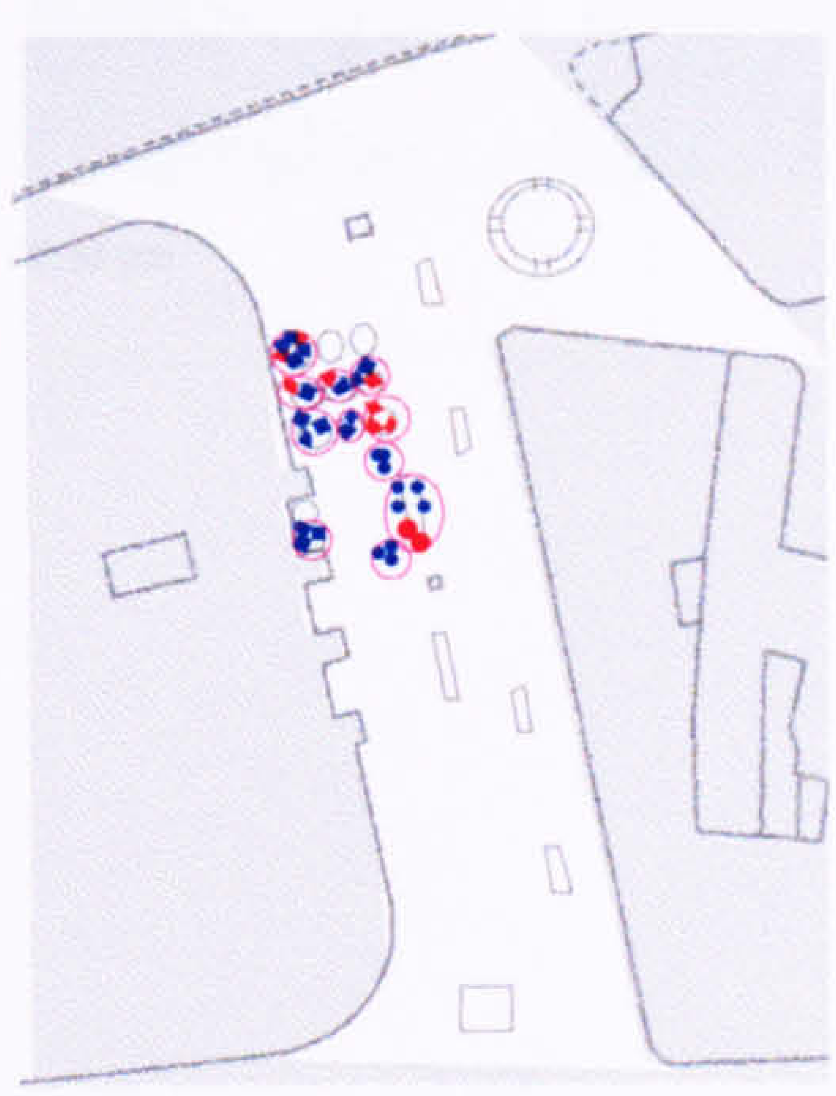


1:10 pm

3:40 pm



5:40 pm



7:00 pm

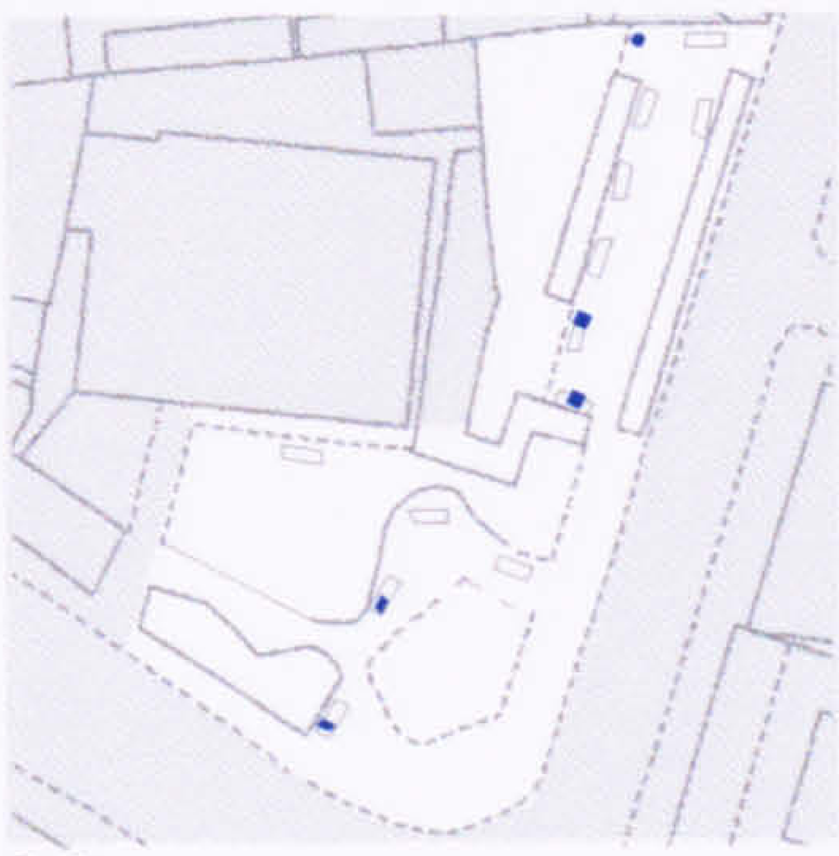
● City worker male
● City worker female
● office smokers
● tourists
● others

talking
sitting
standing
* no one observed

19th July 96, mean temperature = 19.1 C, sunny

Plate 6.19. Pattern of static people distribution: St. Anne & St. Agnes churchyard (1/2)

scale: 1:1200



8:40 am

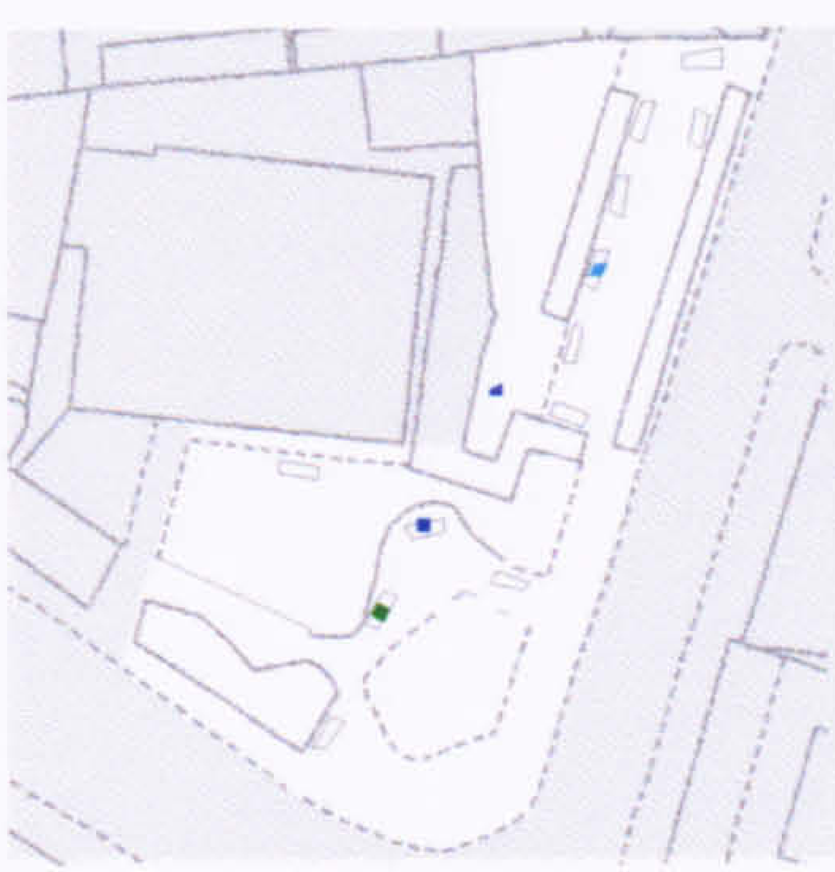
10:40 am

12:10 pm

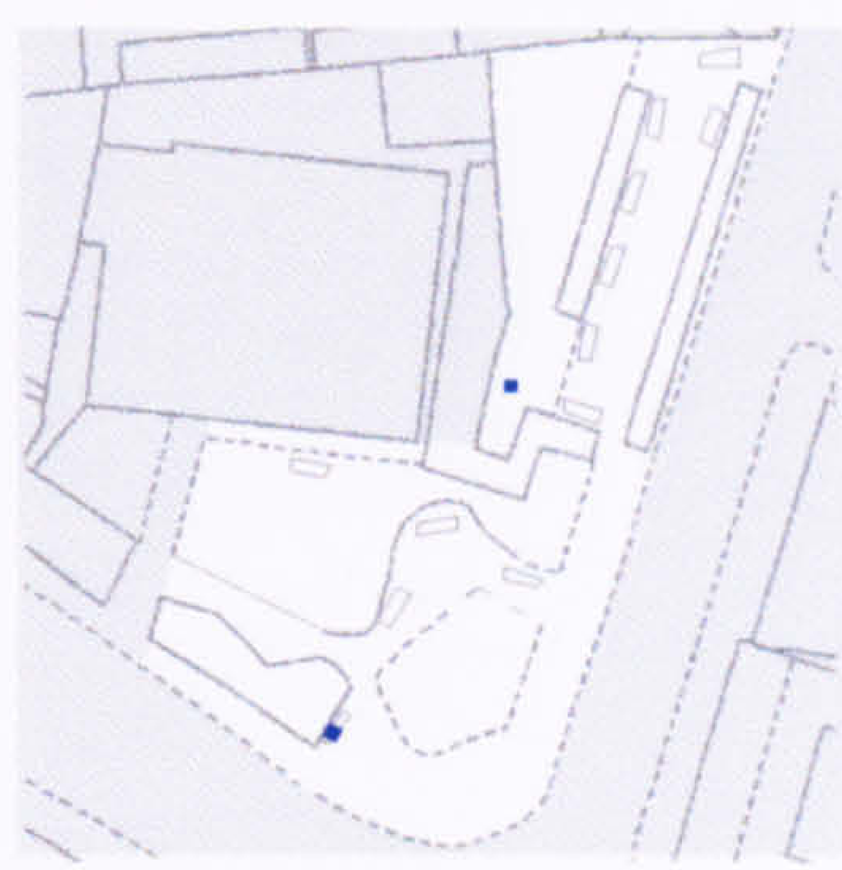
12:40 pm

1:10 pm

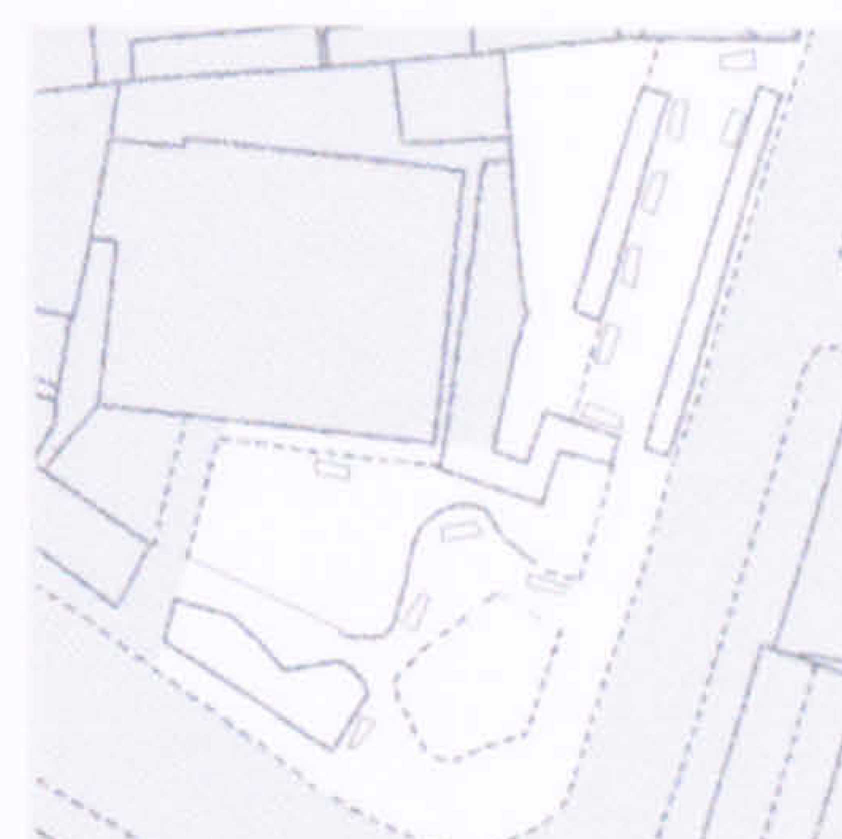
3:40 pm *



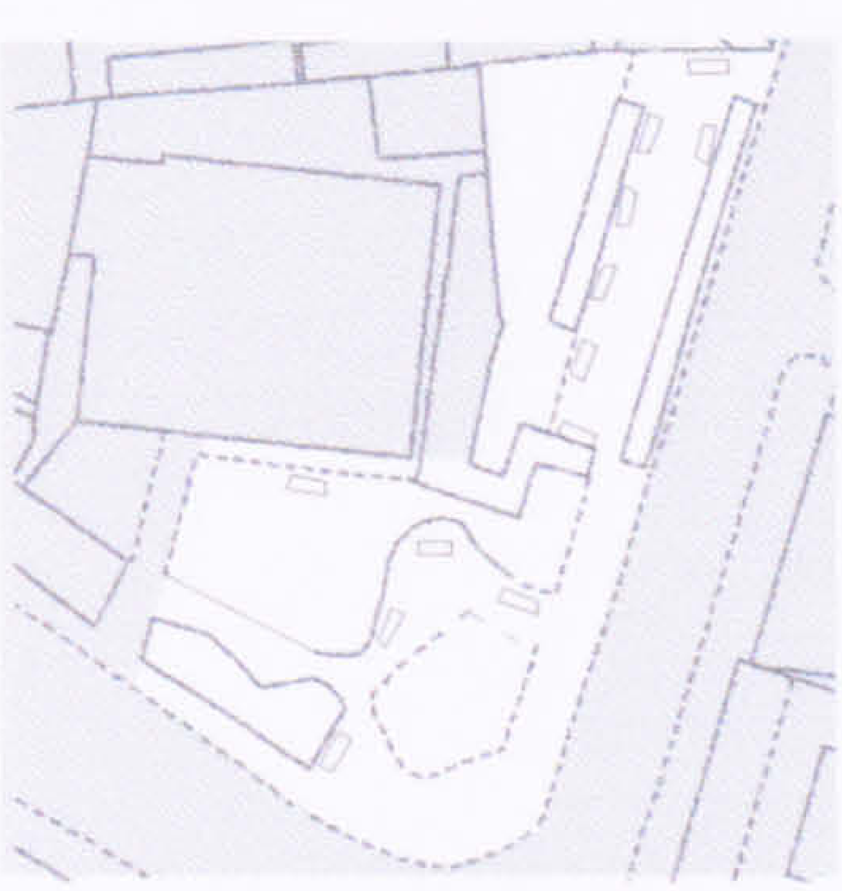
4:40 pm



5:40 pm



6:40 pm *



7:40 pm *

City worker male
City worker female
office smokers
tourists
others

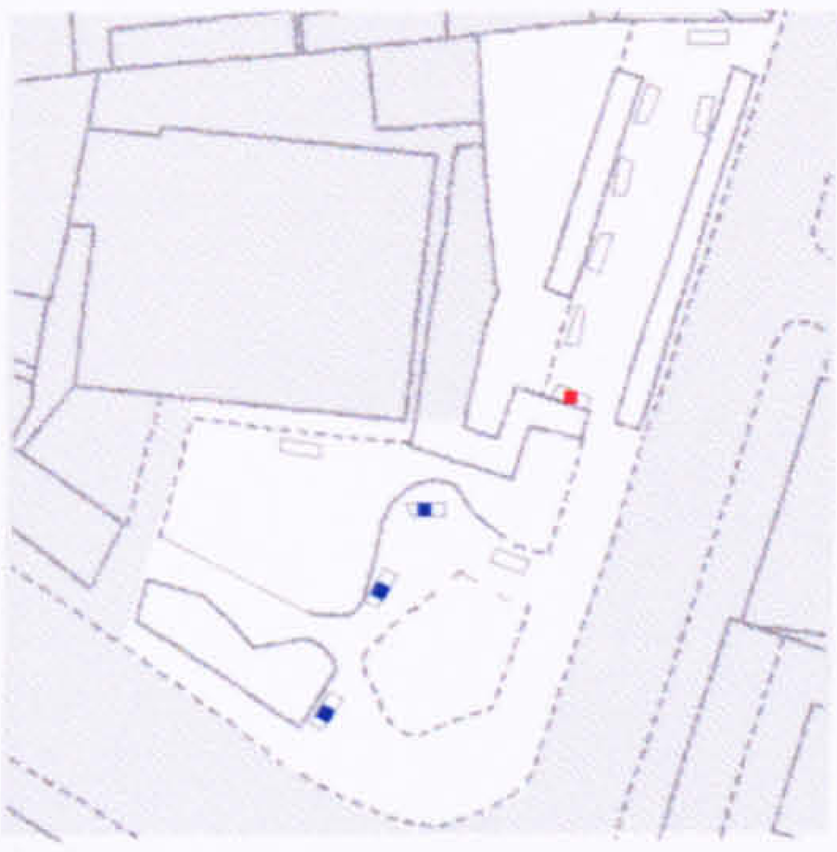
talking
sitting
standing

* no one observed

22nd July 96, mean temperature = 24.7 C, sunny

Plate 6.19. Pattern of static people distribution: St. Anne & St. Agnes churchyard (2/2)

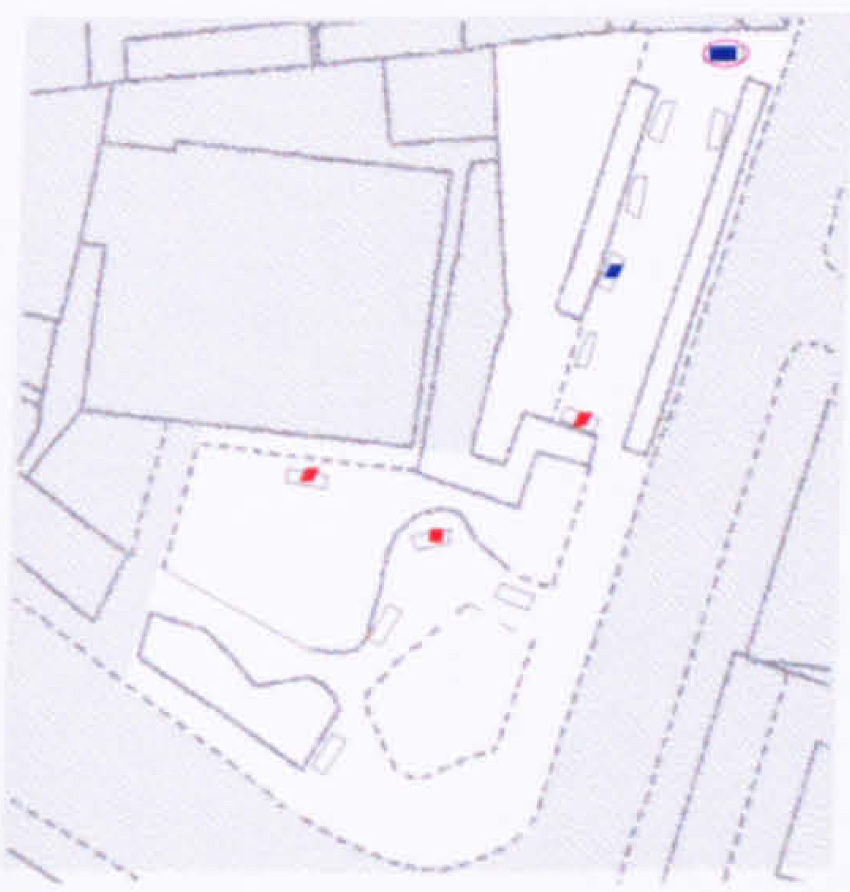
scale: 1:1200



8:40 am

10:40 am

12:10 pm

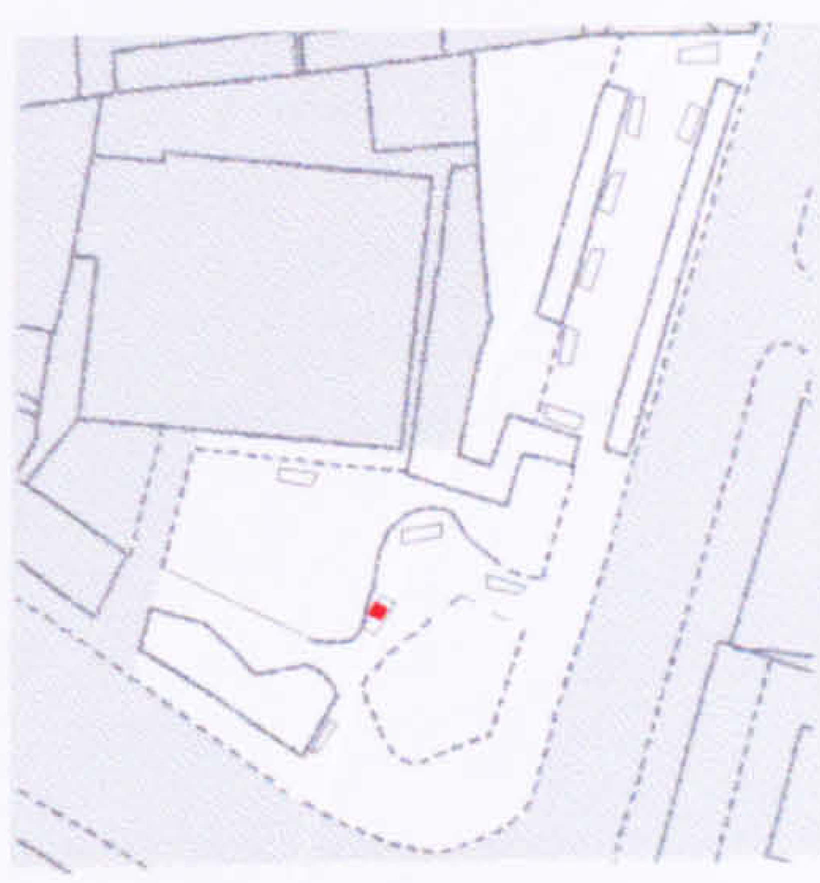


12:40 pm

1:10 pm

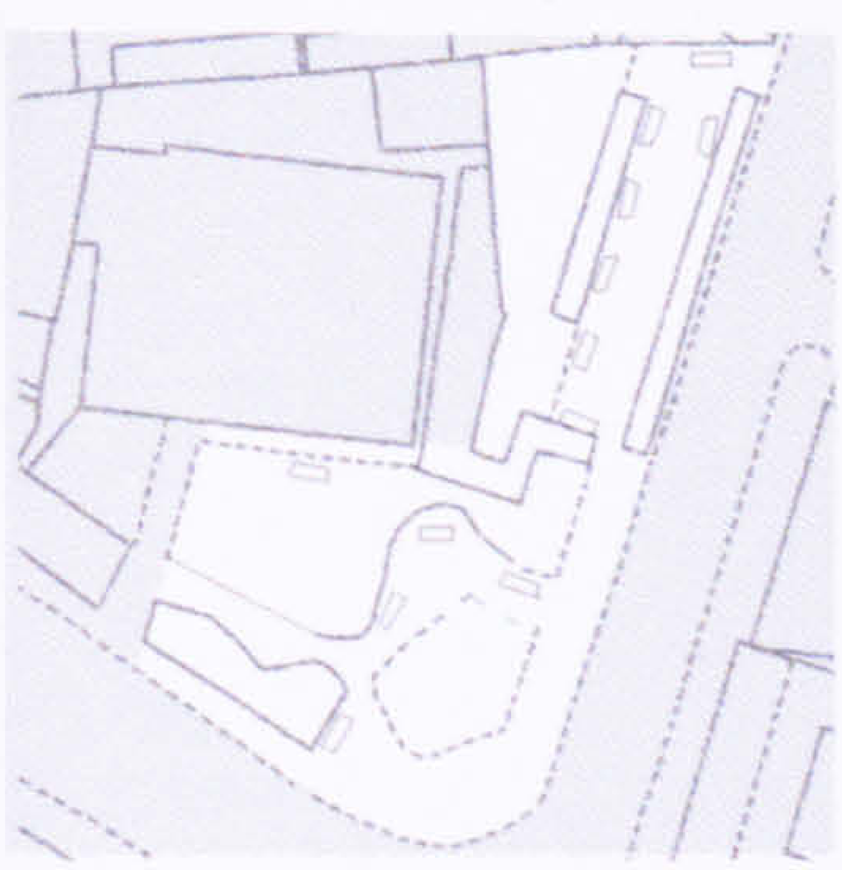
3:40 pm

4:40 pm *



5:40 pm

6:40 pm



7:40 pm *

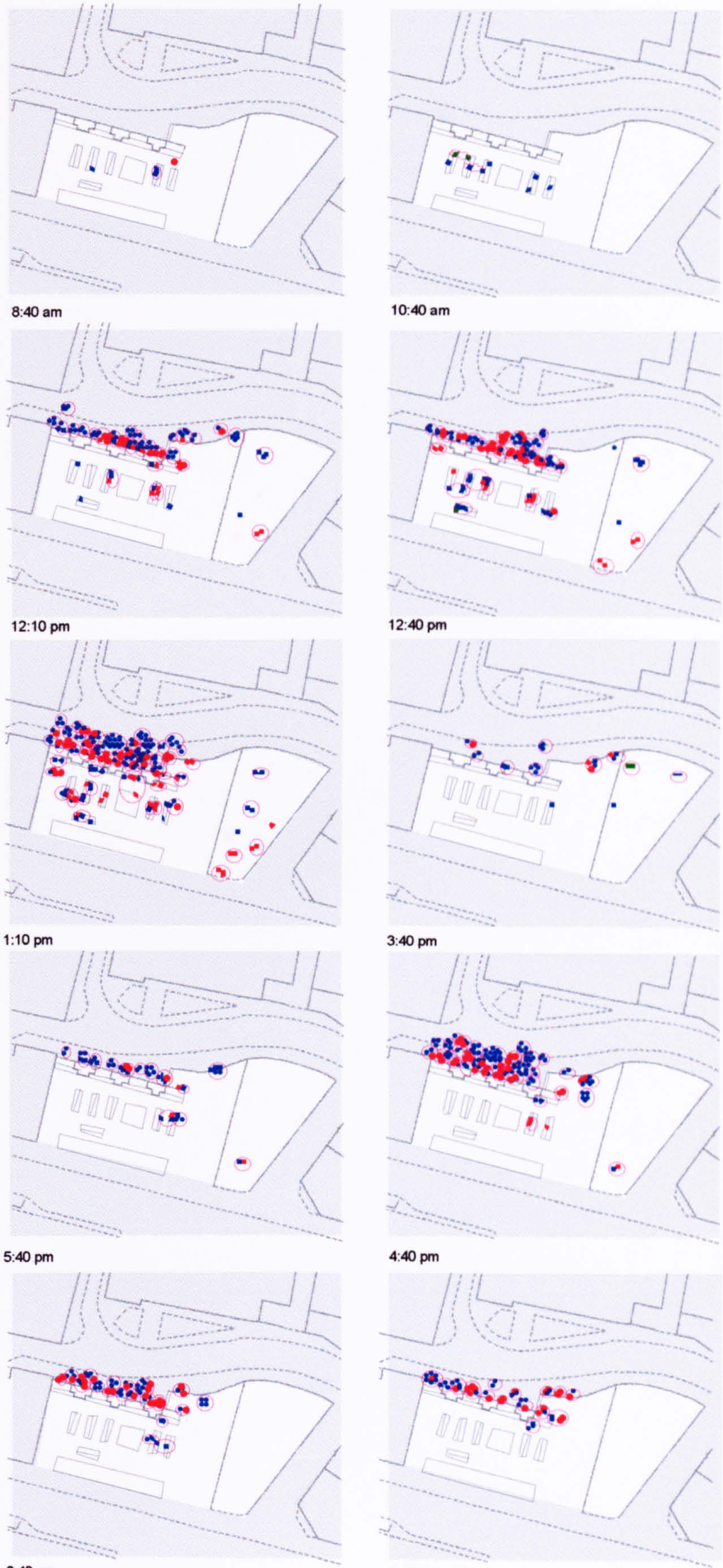
City worker male
City worker female
office smokers
tourists
others

talking
sitting
standing
* no one observed

3rd August 96, mean temperature = 18.1 C, sunny

Plate 6.20. Pattern of static people distribution: Whittingon Gardens (1/2)

scale: 1:1200



26th July 96, mean temperature = 21.7 C
sunny

● City worker male
● City worker female
● office smokers
● tourists
● others

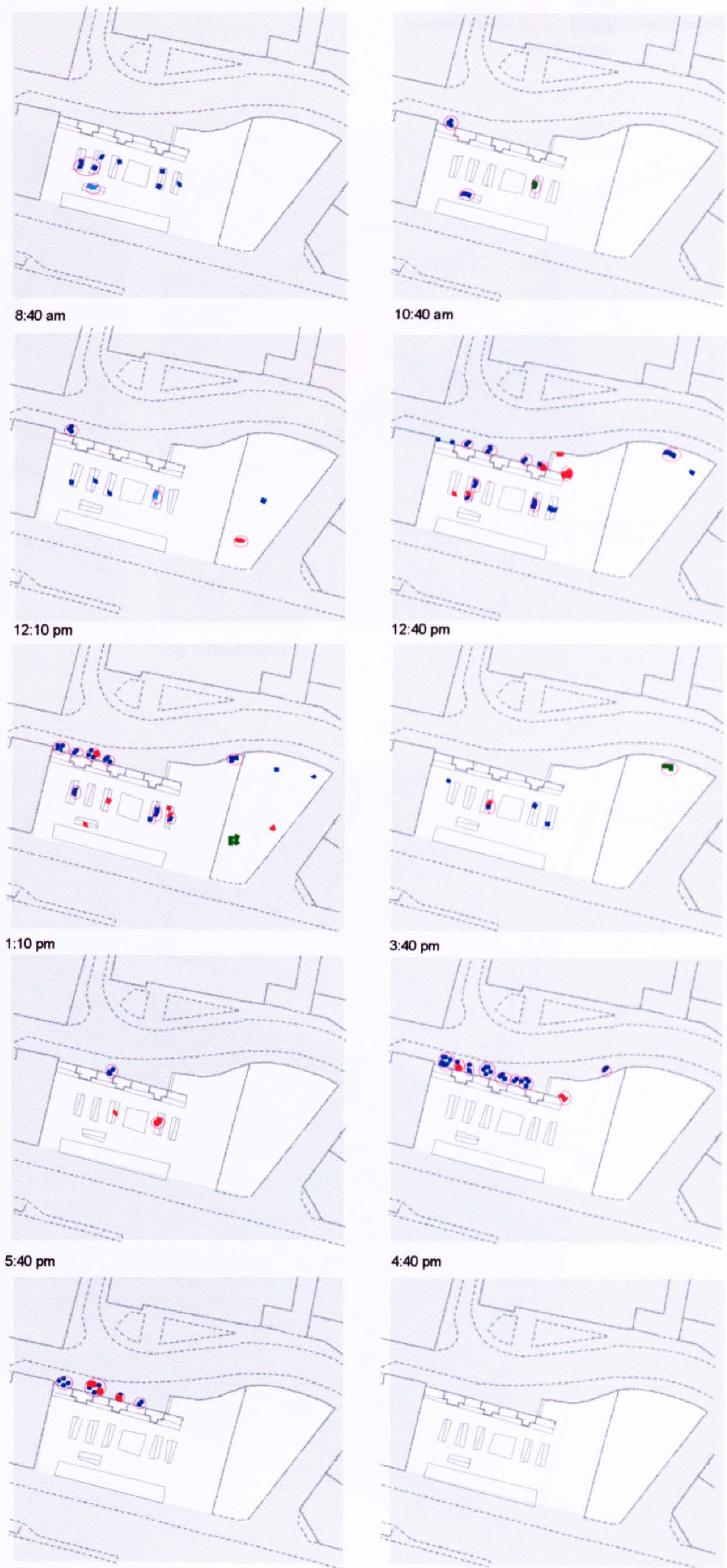
talking

sitting
standing

* no one observed

Plate 6.20. Pattern of static people distribution: Whittingon Gardens (2/2)

scale: 1:1200



1st August 96, mean temperature = 17.9 C
cloudy

- City worker male
- City worker female
- office smokers
- tourists
- others

talking

sitting
standing

* no one observed

Plate 6.24. Static occupancy and overlapping point isovists maps - 10:40 am

scale: 1:1000

all data shown refer to day 1, 10:40 am, unless otherwise stated

(1/4)

eating and/or drinking
relaxing
reading
talking

wine bar users
smoking

maximum coverage density

minimum coverage density

high med. low

Fig. 1. Abchurchyard

Fig. 2. Bank Corner

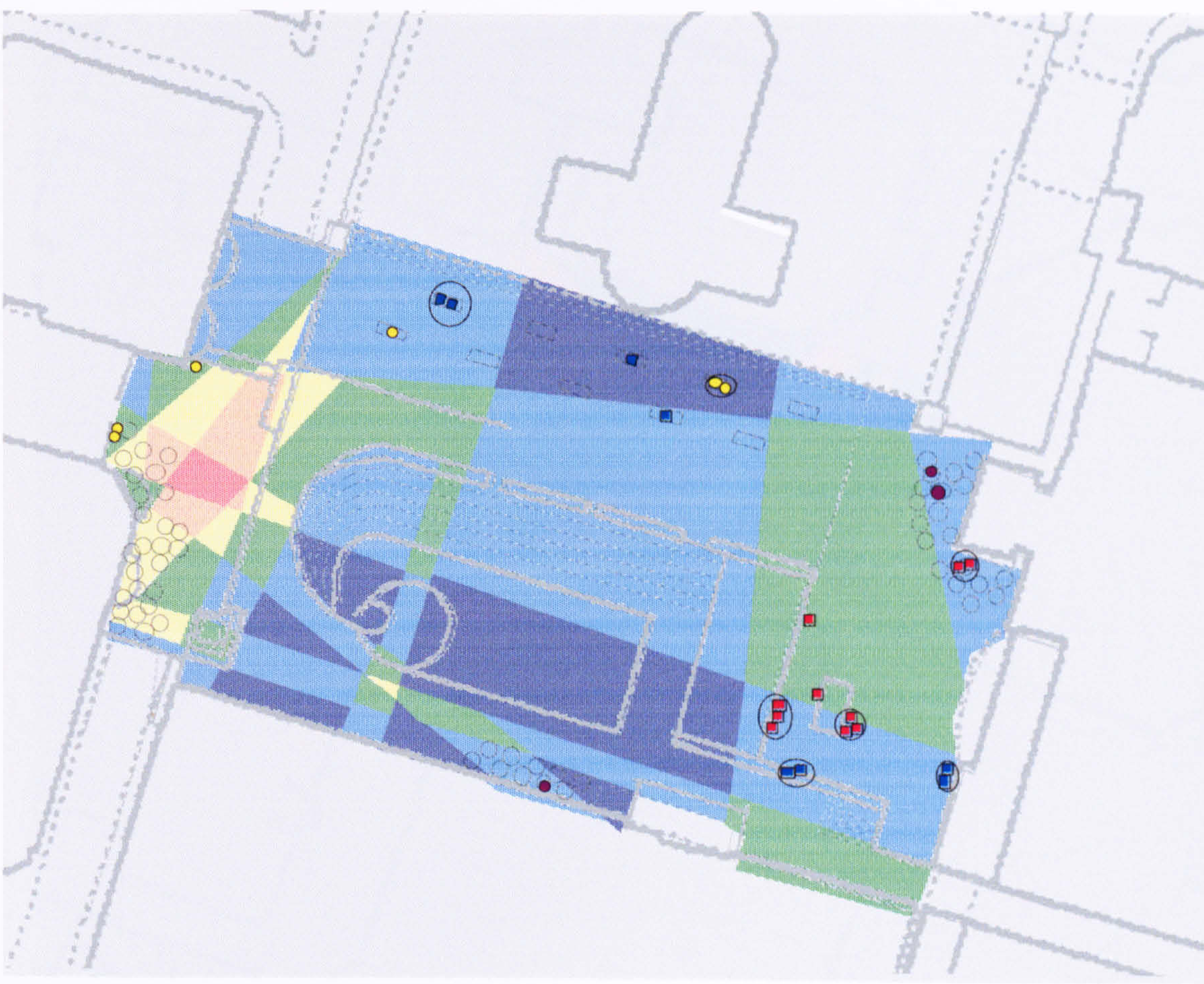


Fig. 3. Exchange Square

Plate 6.24. Static occupancy and overlapping point isovists maps - 10:40 am

scale: 1:1000

(2/4)

all data shown refer to day 1, 10:40 am, unless otherwise stated

eating and/or drinking
relaxing
reading
talking

wine bar users
smoking

maximum coverage density — high — med. — low — minimum coverage density

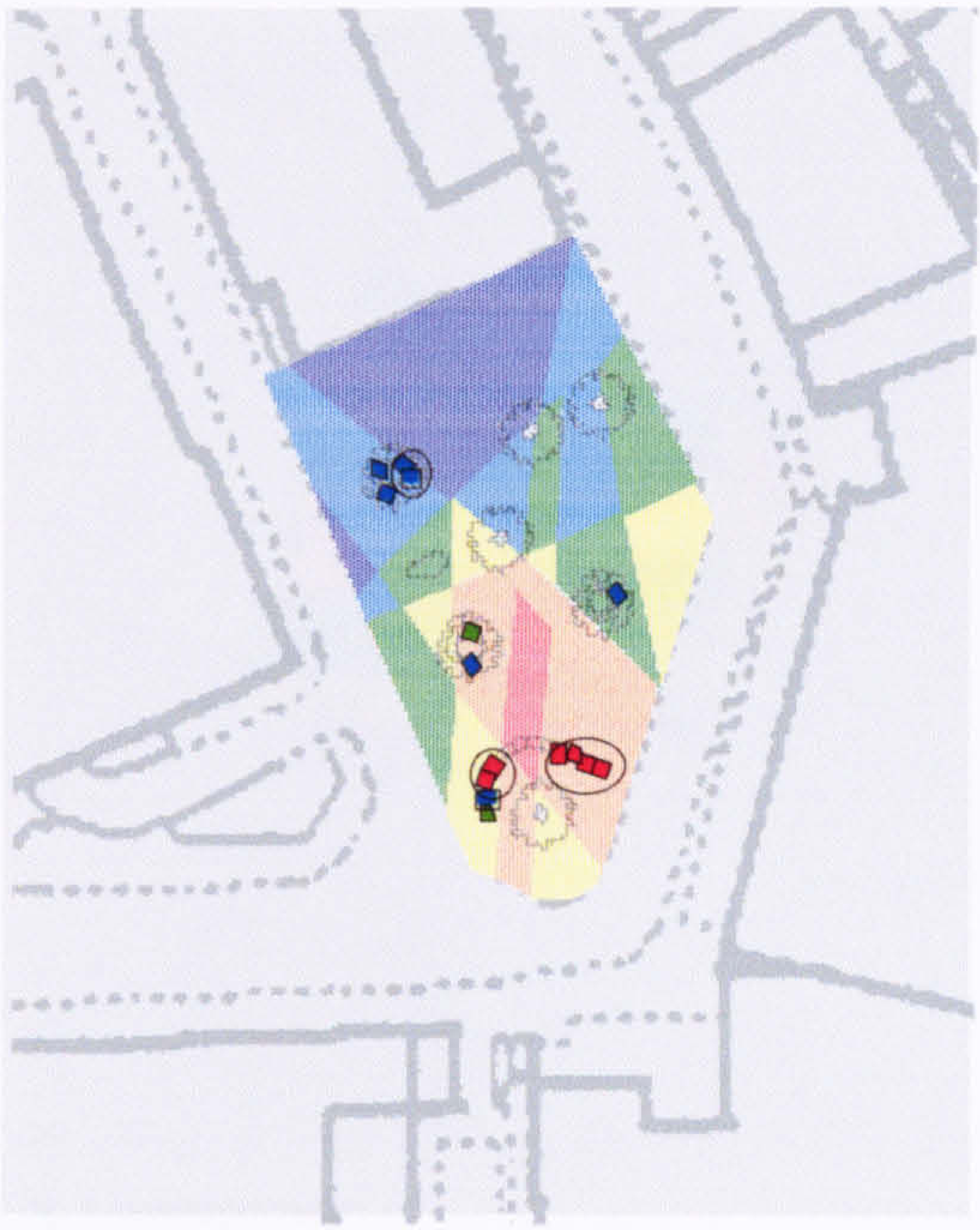


Fig. 4. Fenchurch Place

Fig. 6. Fleet Place

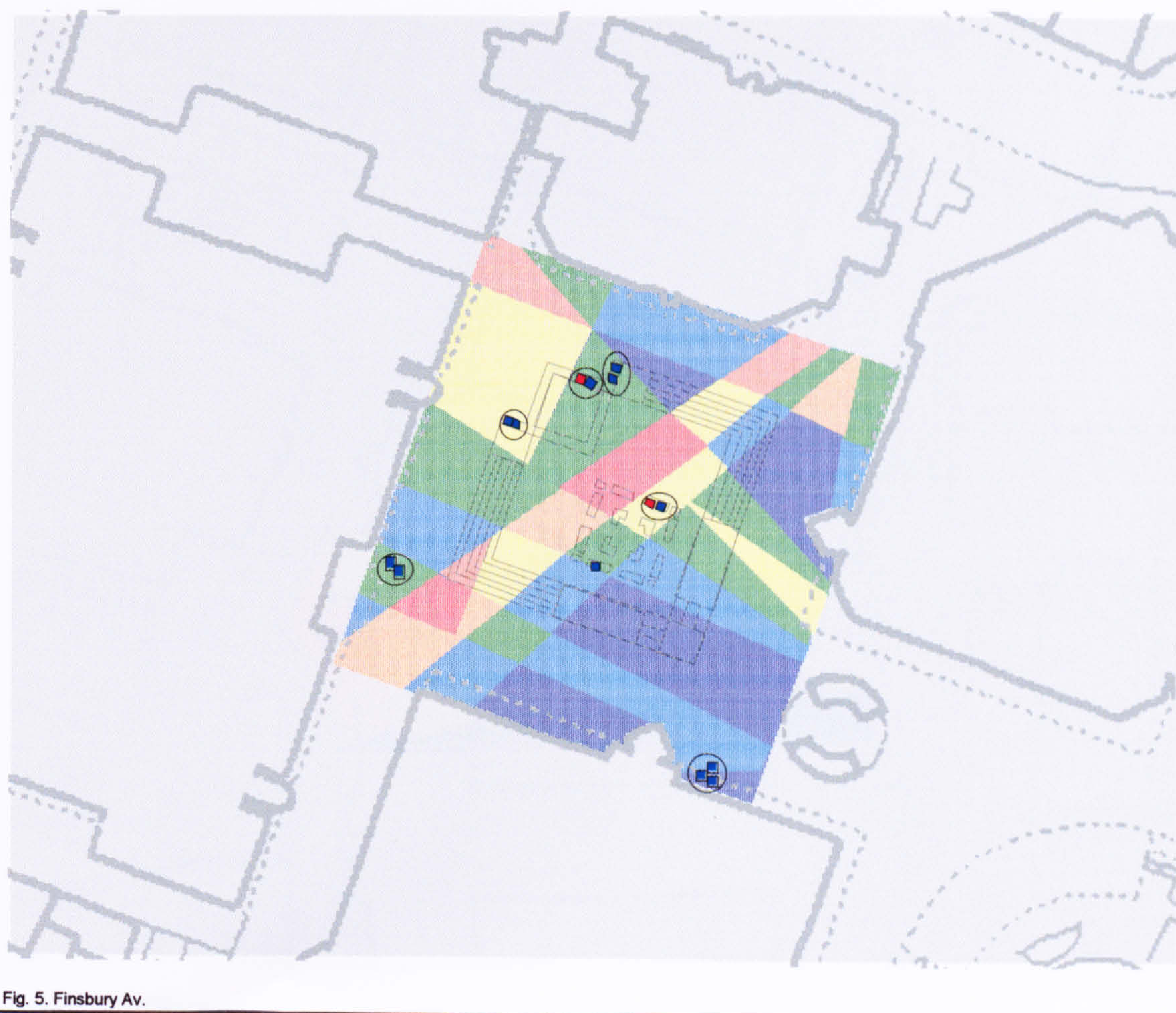


Fig. 5. Finsbury Av.

Plate 6.24. Static occupancy and overlapping point isovists maps - 10:40 am

scale: 1:1000

all data shown refer to day 1, 10:40 am, unless otherwise stated

(3/4)

eating and/or drinking
relaxing
reading
talking

wine bar users
smoking

maximum coverage density — high — med. — low — minimum coverage density

Fig. 7. Love Lane Corner

Fig. 8. New Change/Cheapside Corner
day 1, 4:40 pm

Fig. 9. North Guildhall

Plate 6.24. Static occupancy and overlapping point isovists maps - 10:40 am

scale: 1:1000

(4/4)

all data shown refer to day 1, 10:40 am, unless otherwise stated

eating and/or drinking
relaxing
reading
talking

wine bar users
smoking

maximum coverage density — high — med. — low — minimum coverage density

Fig. 10. Royal Exchange

Fig. 11. St. Anne & St. Agnes churchyard

Fig. 12. Whittington Gardens

Plate 6.24. Static occupancy and overlapping point isovists maps - 10:40 am

scale: 1:1000

all data shown refer to day 1, 10:40 am, unless otherwise stated

(1/4)

eating and/or drinking
relaxing
reading
talking

wine bar users
smoking

maximum coverage density — high — med. — low — minimum coverage density

Fig. 1. Abchurchyard

Fig. 2. Bank Corner

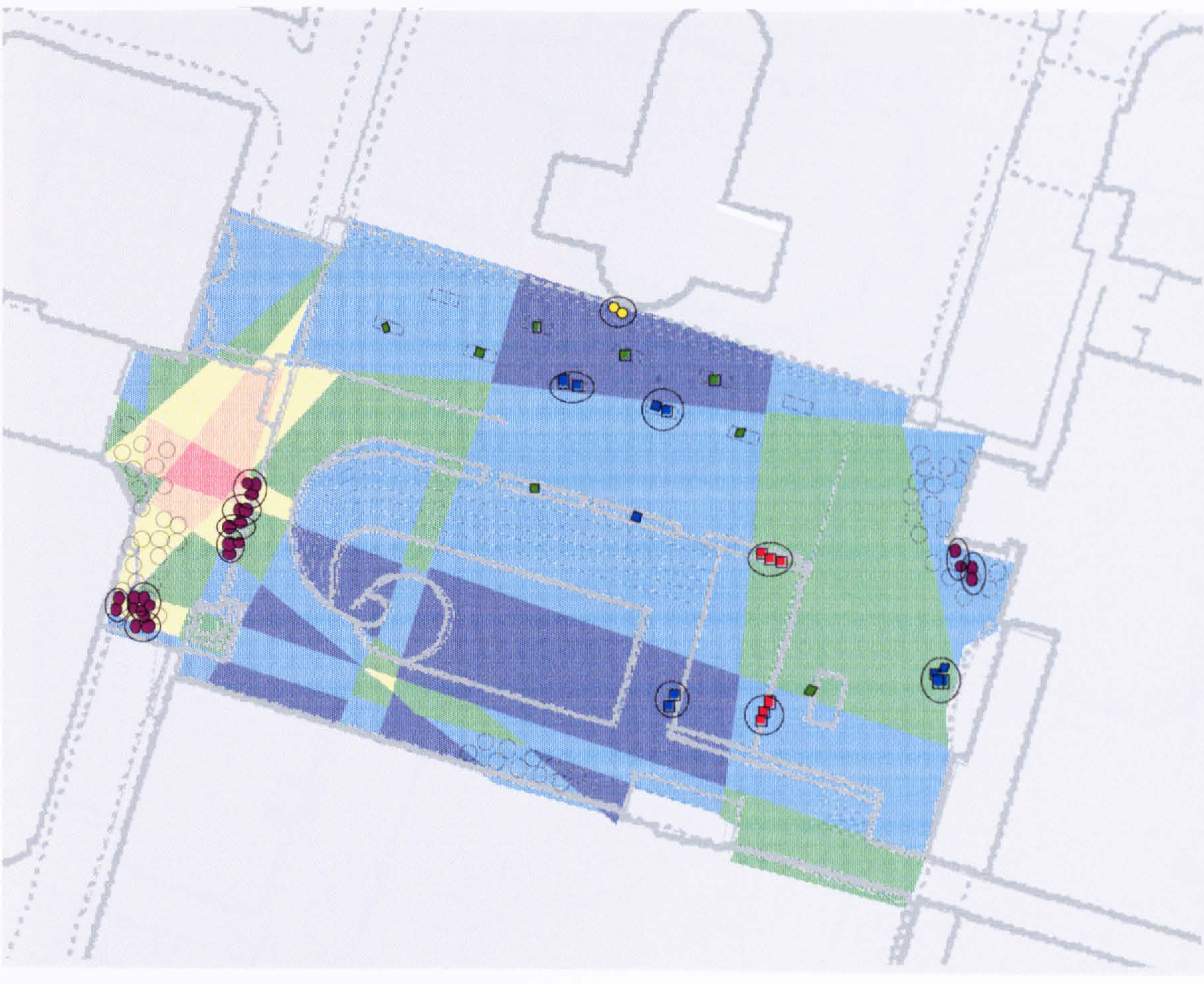


Fig. 3. Exchange Square

Plate 6.24. Static occupancy and overlapping point isovists maps - 10:40 am

scale: 1:1000

all data shown refer to day 1, 10:40 am, unless otherwise stated

(2/4)

eating and/or drinking
relaxing
reading
talking

wine bar users
smoking

maximum coverage density — high — med. — low — minimum coverage density

Fig. 4. Fenchurch Place

Fig. 6. Fleet Place

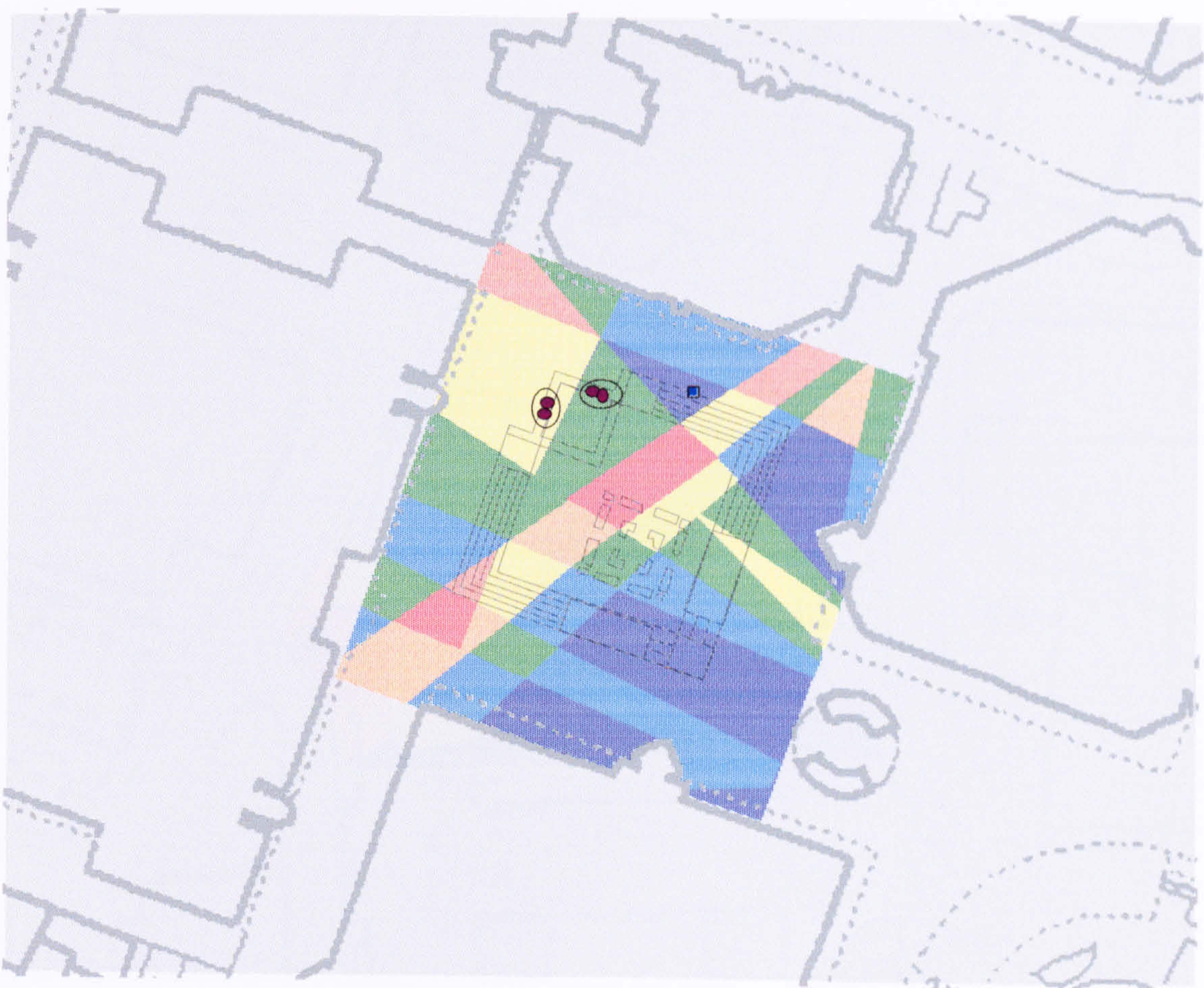


Fig. 5. Finsbury Av.

Plate 6.24. Static occupancy and overlapping point isovists maps - 10:40 am

scale: 1:1000

all data shown refer to day 1, 10:40 am, unless otherwise stated

(3/4)

eating and/or drinking
relaxing
reading
talking

wine bar users
smoking

maximum coverage density — high — med. — low — minimum coverage density

Fig. 7. Love Lane Corner

Fig. 8. New Change/Cheapside Corner

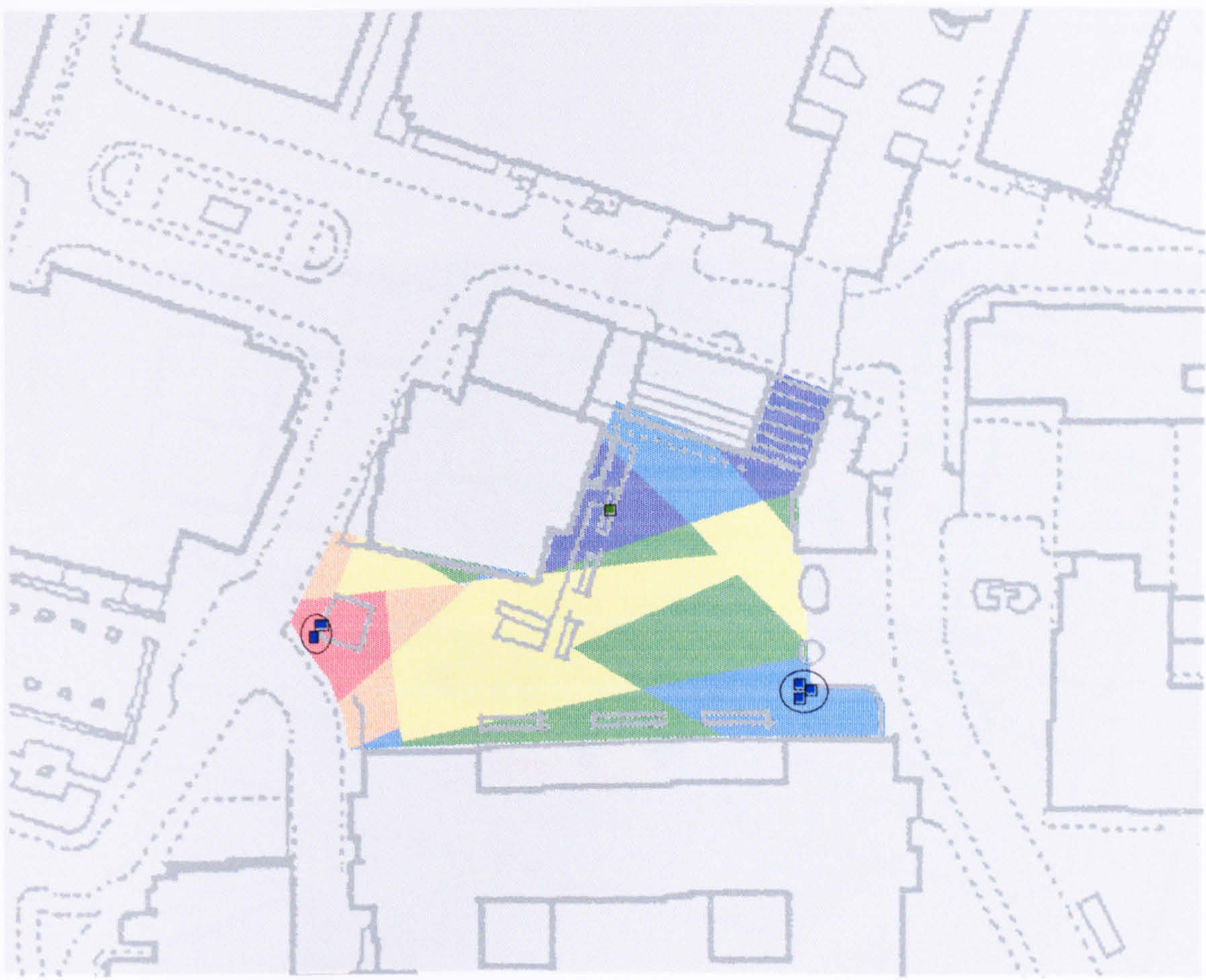


Fig. 9. North Guildhall

Plate 6.24. Static occupancy and overlapping point isovists maps - 10:40 am

scale: 1:1000

all data shown refer to day 1, 10:40 am, unless otherwise stated

(4/4)

eating and/or drinking
relaxing
reading
talking

wine bar users
smoking

maximum coverage density — high, med., low — minimum coverage density

Fig. 10. Royal Exchange

Fig. 11. St. Anne & St. Agnes churchyard

Fig. 12. Whittington Gardens

Table 6.13. Questionnaires replies (1/3)

Public spaces names	Gender	Direct view	Distance to sp. (m)	Activity	Frequency	Reason 1	Reason 2/3
Abchurchyard	male	no	157.77	eat/drinking	occasionally	between work. places	food/drink retails/no seats sdwich shop
Abchurchyard	female	no	104.57	eat/drinking	twice week	others	close to work
Abchurchyard	male	yes	27.52	reading	3 times week	close to work	food/drink retails
Abchurchyard	female	yes	18.35	relaxing	4 times week	close to work	•
Abchurchyard	male	no	157.77	eat/drinking	once fortnight	close to work	food/drink retails
Abchurchyard	male	no	73.38	eat/drinking	once month	close to work	good seats
Abchurchyard	female	no	47.70	eat/drinking	twice week	quiet	good seats
Abchurchyard	female	no	73.38	relaxing	once fortnight	close to work	good seats
Abchurchyard	male	no	209.13	eat/drinking	occasionally	food/drink retails	•
Abchurchyard	female	no	124.75	eat/drinking	3 times week	close to work	•
Bank Corner	male	no	480.64	eat/drinking	occasionally	between work. places	•
Bank Corner	male	no	493.48	eat/drinking	occasionally	between work. places	•
Bank Corner	female	no	154.10	eat/drinking	once week	good seats	•
Bank Corner	male	no	143.09	reading	every day	close to work	•
Bank Corner	female	no	135.75	reading	once week	between work. places	•
Bank Corner	female	no	231.15	eat/drinking	once week	good seats	•
Bank Corner	male	yes	80.72	reading	3 times week	close to work	•
Bank Corner	female	no	121.08	eat/drinking	first time	between work. places	•
Bank Corner	male	no	143.09	relaxing	4 times week	good seats	•
Bank Corner	male	no	352.22	eat/drinking	twice week	between work. places	•
Bank Corner	male	no	374.24	eat/drinking	twice week	between work. places	•
Bank Corner	male	yes	62.37	eat/drinking	every day	close to work	•
Exchange Sq.	male	yes	58.7	relaxing	4 times week	close to work	•
Exchange Sq.	male	yes	91.72	eat/drinking	once week	others (sun)	close to work/pleasant
Exchange Sq.	male	no	421.93	eat/drinking	once week	others (only one know)	•
Exchange Sq.	male	no	326.54	eat/drinking	once week	others (only one know)	•
Exchange Sq.	female	yes	88.06	eat/drinking	once week	between work. places	•
Exchange Sq.	female	yes	58.70	eat/drinking	once week	between work. places	•
Exchange Sq.	female	yes	88.06	reading	once week	watch events	quiet
Exchange Sq.	male	yes	91.72	eat/drinking	once month	close to work	food/drink retails
Exchange Sq.	male	no	176.11	eat/drinking	once month	close to work	food/drink retails
Exchange Sq.	male	no	271.51	eat/drinking	first time	food/drink retails	between work. places
Exchange Sq.	female	no	728.30	eat/drinking	once week	watch events	•
Exchange Sq.	male	yes	58.70	eat/drinking	4 times week	close to work	•
Exchange Sq.	female	no	99.06	reading	4 times week	close to work	•
Fenchurch Pl.	male	no	333.88	reading	once month	close to work	•
Fenchurch Pl.	female	no	311.86	eat/drinking	first time	shops nearby	•
Fenchurch Pl.	female	no	71.55	eat/drinking	4 times week	close to work	good seats/food retail
Fenchurch Pl.	male	no	374.24	eat/drinking	twice week	quiet	green
Fenchurch Pl.	male	yes	31.19	eat/drinking	3 times week	close to work	•
Fenchurch Pl.	female	no	539.34	eat/drinking	3 times week	quiet	far work/ ≠ faces
Fenchurch Pl.	female	no	341.22	eat/drinking	first time	shops nearby	•
Fenchurch Pl.	male	no	304.53	eat/drinking	occasionally	shops nearby	•
Fenchurch Pl.	male	yes	31.19	reading	every day	good seats	close to work
Fenchurch Pl.	female	no	587.04	eat/drinking	first time	food/drink retails	•

Table 6.13. Questionnaires replies (2/3)

Public spaces names	Gender	Direct view	Distance to sp. (m)	Activity	Frequency	Reason 1	Reason 2/3
Finsbury Av.	male	no	150.43	eat/drinking	every day	pleasant	green
Finsbury Av.	female	yes	60.54	eat/drinking	once month	close to work	•
Finsbury Av.	female	no	227.48	eat/drinking	every day	pleasant	•
Finsbury Av.	male	no	124.75	eat/drinking	once month	food/drink retails	•
Finsbury Av.	male	yes	44.03	reading	twice week	close to work	•
Finsbury Av.	female	no	80.72	eat/drinking	once week	close to work	•
Finsbury Av.	male	no	381.58	eat/drinking	first time	between work. places	others
Finsbury Av.	male	no	366.90	eat/drinking	first time	between work. places	•
Finsbury Av.	male	no	172.44	reading	twice week	close to work	food/drink retails
Finsbury Av.	male	yes	60.54	eat/drinking	3 times week	close to work	•
Finsbury Av.	female	yes	60.54	eat/drinking	4 times week	close to work	•
Fleet Place	male	no	201.79	eat/drinking	3 times week	others	•
Fleet Place	female	no	117.41	relaxing	once month	pleasant	•
Fleet Place	male	yes	51.37	eat/drinking	every day	close to work	•
Fleet Place	female	yes	51.37	relaxing	every day	between work. places	•
Fleet Place	male	no	137.59	eat/drinking	once month	close to work	pleasant
Fleet Place	female	yes	55.03	reading	every day	close to work	quiet
Fleet Place	female	yes	69.71	reading	4 times week	close to work	•
Fleet Place	male	yes	62.37	eat/drinking	every day	quiet	close to work
Fleet Place	male	yes	62.37	eat/drinking	twice week	quiet	pleasant
Fleet Place	male	yes	51.37	eat/drinking	every day	good seats	Quiet/spacious
Love Lane	male	no	102.73	eat/drinking	3 times week	close to work	green
Love Lane	female	no	69.71	eat/drinking	4 times week	others	•
Love Lane	female	no	341.22	eat/drinking	twice week	others	•
Love Lane	male	no	172.44	reading	once week	close to work	•
Love Lane	male	no	568.70	relaxing	once month	between work. places	shops nearby
Love Lane	female	no	69.71	reading	every day	green	•
Love Lane	female	no	777.83	eat/drinking	once month	shops nearby	good seats
Love Lane	male	no	322.87	reading	occasionally	quiet	•
Love Lane	female	yes	51.37	eat/drinking	3 times week	close to work	•
Love Lane	male	no	212.80	eat/drinking	every day	green	•
New Change	female	yes	64.21	eat/drinking	occasionally	quiet	•
New Change	female	yes	40.36	eat/drinking	3 times week	good seats	•
New Change	male	no	174.28	eat/drinking	occasionally	quiet	•
New Change	female	no	128.42	eat/drinking	first time	shops nearby	•
New Change	female	yes	40.36	eat/drinking	once month	close to work	•
New Change	male	yes	40.36	relaxing	every day	good seats	close to work
New Change	male	no	111.90	eat/drinking	occasionally	food/drink retails	•
New Change	male	no	902.57	eat/drinking	first time	between work. places	•
New Change	female	no	649.41	eat/drinking	first time	between work. places	•
New Change	male	no	304.53	eat/drinking	occasionally	close to work	food/drink retails
New Change	female	no	238.49	relaxing	first time	close to work	good seats

Table 6.13. Questionnaires replies (3/3)

Public spaces names	Gender	Direct view	Distance to sp. (m)	Activity	Frequency	Reason 1	Reason 2/3
North Guild.	female	no	150.43	reading	twice week	good seats	watch events
North Guild.	male	no	113.74	eat/drinking	once month	watch events	•
North Guild.	male	no	524.67	eat/drinking	occasionally	shops nearby	watch events
North Guild.	female	no	174.28	eat/drinking	first time	shops nearby	•
North Guild.	female	yes	29.35	eat/drinking	every day	close to work	•
North Guild.	female	no	187.12	relaxing	occasionally	others	•
North Guild.	female	no	229.31	eat/drinking	once week	others	•
North Guild.	female	no	234.82	eat/drinking	every day	pleasant	quiet
North Guild.	male	yes	102.73	eat/drinking	4 times week	others	•
North Guild.	male	no	132.08	eat/drinking	once week	close to work	spacious
Royal Exch.	male	no	165.10	eat/drinking	every day	food/drink retails	•
Royal Exch.	male	no	399.92	eat/drinking	once week	food/drink retails	•
Royal Exch.	male	no	227.48	eat/drinking	every day	food/drink retails	•
Royal Exch.	female	yes	44.03	reading	every day	close to work	•
Royal Exch.	female	no	209.13	eat/drinking	every day	good seats	•
Royal Exch.	female	no	80.72	relaxing	every day	close to work	•
Royal Exch.	male	no	687.94	eat/drinking	3 times week	food/drink retails	others
Royal Exch.	female	yes	25.68	eat/drinking	every day	close to work	food/drink retails
Royal Exch.	male	yes	44.03	eat/drinking	every day	close to work	•
Royal Exch.	male	yes	44.03	eat/drinking	every day	close to work	•
St. Anne	male	no	168.77	eat/drinking	twice week	green	close to work
St. Anne	male	no	55.03	relaxing	every day	close to work	only one around
St. Anne	male	no	124.75	eat/drinking	3 times week	close to work	good seats
St. Anne	female	no	119.24	eat/drinking	twice week	quiet	•
St. Anne	male	no	554.02	eat/drinking	once week	quiet	far work
St. Anne	female	no	121.08	relaxing	every day	close to work	food/drink retails
St. Anne	female	yes	55.03	relaxing	twice week	close to work	•
St. Anne	male	no	119.24	relaxing	first time	quiet	close to work
St. Anne	female	yes	77.05	relaxing	every day	close to work	quiet
St. Anne	male	no	568.70	eat/drinking	3 times week	close to work	quiet/green
Whittington Gs.	female	no	102.73	eat/drinking	every day	close to work	•
Whittington Gs.	female	no	110.07	eat/drinking	4 times week	close to work	others
Whittington Gs.	male	no	110.07	relaxing	3 times week	close to work	•
Whittington Gs.	male	no	110.07	eat/drinking	once month	close to work	•
Whittington Gs.	female	no	414.60	eat/drinking	once month	between work. places	•
Whittington Gs.	male	no	100.90	eat/drinking	first time	food/drink retails	•
Whittington Gs.	female	no	121.08	eat/drinking	3 times week	close to work	good seats
Whittington Gs.	male	no	337.55	eat/drinking	once month	good seats	food/drink retails
Whittington Gs.	female	no	102.73	eat/drinking	twice week	close to work	quiet
Whittington Gs.	female	yes	62.37	reading	twice week	close to work	quiet